JOURNAL
OF THE
FEDERATION
OF
INSURANCE INSTITUTES
OF
GREAT BRITAIN AND IRELAND.

THE FEDERATION OF INSURANCE INSTITUTES
OF GREAT BRITAIN AND IRELAND.

JOURNAL

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FEDERATION OF INSURANCE INSTITUTES

OF

GREAT BRITAIN AND IRELAND.

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DAVID L. LAIDLAW, Manager, *North British and Mercantile Insurance Company*, Glasgow.

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F. DALTON (*Norwich Union*, Birmingham), 1898.
J. B. TENNANT, F.I.A. (*Friends' Provident*, Bradford), 1899.
S. G. MOXEY (*Prudential*, Bristol), 1900.

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THE FEDERATION OF INSURANCE INSTITUTES OF GREAT BRITAIN AND IRELAND.

RECEIPTS. — *For Year ending June 30th,* 1899. — *PAYMENTS.*

Receipts	£ s. d.	Payments	£ s. d.	£ s. d.
To Levies from Institutes ...	£68 11 0	By Expenses *re* Journal—		
,, Sale of Journals ...	126 6 7	Printing ...	£147 14 0	
,, Fees from 129 Candidates for Examination ...	32 5 0	Postages and Petty Cash ...	2 15 11	
,, Subscriptions from Insurance Offices ...	159 14 0			£150 9 11
,, Advertisements in Journal ...	4 14 6	,, Expenses *re* Examinations—		
,, Bank Interest ...	1 5 7	Printing and Stationery ...	£56 18 6	
		Postages ...	8 11 6	
		Certificates ...	20 0 0	
				85 10 0
		,, General Expenses—		
		Secretary's Salary ...	£25 0 0	
		Printing and Stationery ...	9 18 0	
		Petty Cash ...	11 7 1	
				46 5 1
		,, Balance forward ...		110 11 8
	£392 16 8			£392 16 8

RECEIPTS. — *For Six Months ending December 31st,* 1899. — *PAYMENTS.*

Receipts	£ s. d.	Payments	£ s. d.	£ s. d.
To Balance from previous Account ...	£110 11 8	By Examination Expenses—		
,, Sale of Journals ...	10 1 3	Stationery ...	£7 12 1	
,, Bank Interest ...	0 13 5	Petty Cash and Postages ...	1 15 1	
				£9 7 2
		,, Orphanage Scheme—		
		Stationery ...	£3 9 11	
		Petty Cash and Postages ...	5 5 1	
				8 15 0
		,, Journal—Petty Cash and Postages ...		0 16 8
		,, General Expenses—		
		Secretary's Salary ...	£12 10 0	
		,, Allowance Office Expenses	7 10 0	
		Petty Cash and Postages ...	2 3 2	
				22 3 2
		,, Balance (in Bank) ...		80 4 4
	£121 6 4			£121 6 4

Audited and found correct, May 8th, 1900.

ROBERT TAYLOR,
JAMES OSTLER, } *Auditors.*

THE
FEDERATION OF INSURANCE INSTITUTES
OF
GREAT BRITAIN AND IRELAND.

BIRMINGHAM INSURANCE INSTITUTE.

Founded 1887.

Objects: (1st) The reading of papers and delivering of lectures by members, or experts who are not members, upon subjects connected with Insurance business generally. (2nd) The discussion of all questions relating to such business. (3rd) The promotion of social intercourse amongst members of the profession in Birmingham and district.

Ordinary General Meetings are held on the last Friday in each month from October to March, both inclusive. The Annual General Meeting is held at the beginning of each Session.

PRESIDENT—Charles D. Butler, *Royal Exchange.*
VICE-PRESIDENTS—A. J. Lewis. *Sun Fire;* T. W. Jamieson, *North British and Mercantile.*
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HON. SECRETARY—A. E. Patrick, *Patriotic,* 3 Waterloo Street.

INSURANCE INSTITUTE OF BRISTOL.

Founded 1890.

Objects: Social intercourse amongst members and the cultivation of knowledge on Insurance subjects.

PRESIDENT—W. Wilkes Woodhill, *Commercial Union.*
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HON. SECRETARY—James Bolton, *Union,* 24 Clare Street.

INSURANCE AND ACTUARIAL SOCIETY OF GLASGOW.

Established 1881.

Objects: (1st) The promotion of the study of the principles of Fire and Life Assurance, and of Assurance against other contingencies. (2nd) The consideration of all subjects to which the doctrines of probabilities may be applied, as well as the best methods of collecting and applying statistics. (3rd) The consideration of questions bearing on social science or political economy. (4th) The formation of a library of professional works for the use of members.

PRESIDENT—A. K. Rodger, Manager, *Scottish Temperance Life.*

VICE-PRESIDENTS—W. A. Tipping, *Scottish Alliance;* W. Smith Nicol, F.F.A., *City of Glasgow;* David L. Laidlaw, *North British and Mercantile.*

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HON. TREASURER—Stewart Lawrie, *Alliance,* 151 West George Street, Glasgow.

HON. SECRETARY—Henry G. Andrewes, *Scottish Union and National,* 150 West George Street, Glasgow.

INSURANCE INSTITUTE OF IRELAND, DUBLIN.

Founded 1885.

Objects: (1st) The promotion of the study of the principles of Fire and Life Assurance, and of Assurance against other contingencies. (2nd) The consideration of all subjects to which the doctrine of probabilities may be applied, as well as the best methods of collecting and applying statistics. (3rd) An organisation for any purpose necessary for the requirements of the profession. (4th) The promotion of a good understanding amongst the members of the Insurance profession in Ireland.

PRESIDENT—Thomas Speedy, *Union.*

VICE-PRESIDENTS—J. C. Anderson, *Commercial Union;* B. H. O'Reilly, *Patriotic;* C. Chevalier Cream, *National.*

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HON. TREASURER—G. E. Taylor, *London Assurance Corporation.*

HON. LIBRARIAN—Pat. B. Carphin, *Sun.*

HON. SECRETARY—W. B. Tyner, *Standard Life Assurance Company,* 66 Upper Sackville Street, Dublin.

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Founded 1873.

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HON. SECRETARY AND TREASURER—Thomas A. Bentley, *London and Lancashire Fire,* 100 King Street.

INSURANCE ASSOCIATION OF MANCHESTER.

Founded 1883.

Objects: To encourage the delivery of essays and lectures upon subjects connected with Insurance, and discussion thereon; to organise visits of inspection to such risks as the Committee of Management may decide upon; and to promote social intercourse amongst those connected with Insurance Companies.

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HON. TREASURER—A. H. Coombes, *Lancashire.*
HON. SECRETARY—James Fallow, *Liverpool and London and Globe,* 59 King Street, Manchester.

THE INSURANCE INSTITUTE OF NEWCASTLE-ON-TYNE.

Founded 1896.

Objects: (*a*) The reading of papers and the delivery of lectures by members, or experts not members, upon subjects connected with Insurance business generally. (*b*) The discussion of all questions relating thereto. (*c*) The formation of a library for the use of members. (*d*) The promotion of social intercourse amongst the members.

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HON. LIBRARIAN—F. W. Panton, *Norwich Union Fire.*
HON. TREASURER—G. W. Binney, *Lancashire.*
HON. SECRETARY—James Hopper, *Sun.*

NORWICH INSURANCE INSTITUTE.

Founded 1886.

PATRONS—Major F. Astley Cubitt, J.P.; S. Gurney Buxton, D.L., J.P.
PRESIDENT—C. A. Bathurst Bignold, D.L., J P.
VICE-PRESIDENTS—A. R. Anderson, Liverpool; J. F. Cubitt, Bristol; H. D. Curnick, Manchester; A. Dixon, Toronto; J. Montgomery Hare, New York; Henri de Hayn, Paris; John Large, Glasgow; R. K. Mackenzie, Norwich; C E. Noverre, F.R. Hist. S., London; Hugh Panton, Newcastle; F. Oddin Taylor, D.L., J.P., Norwich; J. Templeton, Exeter; J. T. Ward, Belfast; James Watson, Leeds; Joseph Watson, Leeds.
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LIBRARIAN—W. T. Blazeby. MICROSCOPIST AND PHOTOGRAPHER—G. Reeve.
HONORARY SECRETARY—C. R. Quinton, 7 Surrey Street, Norwich.
HONORARY ASSISTANT-SECRERARY—H. A. Smith.

NOTTINGHAM INSURANCE INSTITUTE.

Established 1898.

Objects: The reading of papers and the delivery of lectures upon subjects connected with Insurance business generally, the discussion of all questions relating thereto, and the promotion of social intercourse amongst the members of the profession in Nottingham and district.

PRESIDENT—John Rodger, *Scottish Equitable.*
VICE-PRESIDENT—E. A. Coutts, *North British and Mercantile.*
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HON. SECRETARY AND TREASURER—H. Gayford, *Northern,* 15 Victoria Street.

INSURANCE INSTITUTE OF YORKSHIRE, LEEDS.

Founded 1888.

Objects: The delivery of lectures on subjects connected with Insurance business, the discussion of questions relating thereto, and, generally, the promotion of social intercourse amongst the members of the Insurance profession in Yorkshire. Meetings—Philosophical Hall, Park Row, Leeds.

President—C. M. Tate, *Ocean Accident.*

Past-Presidents (*ex-officio* Members of Council)—J. A. Cunninghame, *Yorkshire;* J. B. Tennant, F.I.A., *Friends' Provident;* T. S. Riley, *Law Union and Crown;* J. Wardle, *Liverpool and London and Globe;* J. B. Roberts, *Sun Fire;* J. H. Mills, *Commercial Union.*

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Hon. Librarian—W. A. Holroyd, *Sun Fire,* 15 Park Row, Leeds.

Hon. Auditors—F. Denton, *Sun Fire;* A. R. James, *North British and Mercantile.*

Hon. Secretary—E. Bagshaw, *Phœnix,* 8 Park Road, Leeds.

Assistant Hon. Secretary—A. Riley, *Law Union and Crown.*

INSTITUTES AFFILIATED WITH THE FEDERATION.

INSURANCE INSTITUTE OF TORONTO.

Founded 1899.

President—Henry Sutherland, Managing Director, *Temperance and General Life Assurance Co.*

Vice-President—J. B. Laidlaw, Manager, *Norwich Union Fire Insurance Society.*

Secretary—William E. Fudger, *British America Assurance Co.*

Assistant Secretary—F. W. Doran, District Inspector, *Standard Life Assurance Co.*

Treasurer—E. W. Cox, Assistant General Manager, *Canada Life Assurance Co.*

Assistant Treasurer—R. H. Williamson, *British America Assurance Co.*

Curator—William Robins, Secretary, *Canadian Fire Underwriters' Association.*

Assistant Curator—W. H. Hall, General Agent, *American Surety Co.* and *New York Plate Glass Insurance Co.*

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THE

FEDERATION OF INSURANCE INSTITUTES

OF

GREAT BRITAIN AND IRELAND.

THE fourth annual Conference was held at the Clifton Down Hotel, Bristol, on the 8th June on the invitation of the Insurance Institute of that city. Mr. S. G. Moxey (*Prudential*), the President of the Federation, occupied the chair, and there were present the following delegates:—

LIST OF DELEGATES, 1900.

President: S. G. MOXEY (*Prudential*).

Hon. Treasurer: Thos. A. Bentley (*London and Lancashire*).

Hon. Secretary to the Examiners: J. B. Roberts (*Sun*).

Hon. Secretary to Bristol Institute: W. Pearce Tapp, junr. (*Sun*).

Birmingham.—A. J. Lewis (*Sun*), Vice-President; Chas. D. Butler (*Royal Exchange*), Vice-President.

Bristol.—J. Y. Crowe (*National Provident*), A. D. Brookes (*Alliance*), J. Mason Guttridge (*Imperial*).

Glasgow.—Adam K. Rodger (Manager, *Scottish Temperance Life*), President; W. Smith Nicol (Manager, *City of Glasgow Life*), Henry G. Andrewes (*Scottish Union and National*), Hon. Secretary.

Ireland.—Thomas Speedy (*Union*), President; W. B. Tyner (*Standard*), Hon. Secretary.

Manchester (Institute).—Charles Povah (*Lancashire*), President; James Ostler (*Northern*), T. B. Miller (*Guardian*), J. W. Bagshaw (*Union*).

Manchester (Association).—R. A. Grant (*Lancashire*), James Fallow (*Liverpool and London and Globe*), Hon. Secretary.

Newcastle-on-Tyne.—Bruce Kelly (*Northern*), Vice-President; James Hopper (*Sun*), Hon. Secretary.

Norwich.—H. D. Curnick (*Norwich Union*), Vice-President; C. R. Quinton (*Norwich Union*), Hon. Secretary.

Nottingham.—J. Rodger (*Scottish Equitable*), President; H. Gayford (*Northern*), Hon. Secretary and Treasurer.

Yorkshire.—J. W. Wootton (*Sun Life*), C. M. Tate (*Ocean*), President.

After the adoption of the minutes of last Conference the Report of the Executive was read as follows:—

REPORT 1899–1900.

The year to 31st May, 1900, has been one of progress in every department.

The chief work of the Federation being educational, it is pleasing to report that the publicity given to the efforts in that direction last year has resulted in the enrolment of a larger number of candidates this year. There were 171 entries this year, as compared with 129 entries in 1899. The actual number who sat was 140, as compared with 110 in 1899. The total number of papers was 518 this year, against 627 last year. Not only do these figures show a gratifying increase, but it is a further satisfaction to know that the candidates are much better distributed over the various centres. The friendly rivalry for distinction between the different Institutes is a hopeful sign of a good work in the future.

Certificates have been issued to 93 students, and a special award of merit has been given to F. E. Colchester (Commercial Union), Bristol, H. Cooke (Liverpool and London and Globe), Leeds, and G. Lithgow (Sun Fire), Leeds, as being the three students whose work has on the whole been adjudged the best.

The Educational Committee has endeavoured to bring the syllabus of the examinations under the notice of every insurance clerk, and thanks are due to the managers and local managers of the offices for kindly assisting the local Institutes in this work by facilitating the distribution of the papers and encouraging the formation of classes for the study of the various subjects. The cost of printing and distributing the

examination syllabus, the examination papers, and the certificates has been considerable, but the results more than warrant the outlay.

The second volume of the "Journal" was published towards the close of last year, and it is an advance on the former volume in several respects. As in the previous year, it contains fifteen papers, contributed by nine Institutes. A new feature of the volume, however, is the inclusion of the President's address and of the examination papers. The papers have been selected with great care by the Publications Committee on a definite plan, with a view to making the "Journal" a repository of the best and latest information on the subjects which are selected for the examination of students from year to year, thus making it a valuable text-book for study by those clerks who are ambitious to qualify themselves for advancement in their profession. The examination papers, which it is proposed to publish in the "Journal" each year, will also be useful. These improvements have increased both the size and the cost of the "Journal," but the demand for it is the best proof that it is fully appreciated. Fifteen hundred copies of both issues have been printed, and there now remains in stock a limited number of both volumes.

The proposed Insurance Clerks' Orphanage scheme has engaged the attention of the Executive during the past year, and, in accordance with a resolution passed at last year's Conference, a circular was widely distributed among the offices explaining the scheme and asking what measure of support would be given it if started. The result of this appeal was on the whole satisfactory, and it will be for the Conference to determine what further action should be taken in the matter.

At the last Conference the question of the affiliation of foreign and colonial Insurance Institutes on such terms and conditions as may be deemed prudent was moved, and correspondence on this subject will be laid before the Conference for their consideration.

The financial statement for the past year, which will be

presented, shows that not only have the federated Institutes contributed generously to the funds, but that the educational work of the Federation is appreciated by the head offices of a large and increasing number of companies from whom substantial support has been received, and to whom the warmest thanks are due for the interest taken in the operations of the Federation. It is perhaps unnecessary to repeat that the entire expenses of the Federation are for the educational work and for the "Journal" (on which no profit is made), together with a small sum for the indispensable secretarial work, and that no part of the funds is expended in social functions.

In concluding their report, the Executive desire to thank the President, Mr S. G. Moxey, for the deep interest he has taken in the work during the past year, the Educational and Publications Sub-Committee for their invaluable labours, the examiners for their onerous work in preparing the examination papers and in checking and reporting on the papers received, the auditors for auditing the accounts, the hon. treasurer for the zealous care he has taken in raising and disbursing the funds of the Federation, and the insurance press for the wide publicity given to all the work of the Federation during the past year.

The PRESIDENT then delivered an address to the delegates. He said:—Gentlemen, my first pleasing duty is to give you all a most hearty welcome to this ancient city, the metropolis of our western land, and which, in respect to its past history, holds a somewhat unique position in the insurance world, for it probably takes precedence over every other centre outside London, as being the city where insurance was carried on before the larger towns of the North and Midlands were themselves in existence, and it is more than likely that the then population of Bristol exceeded the populations of any four of them put together. In searching these old records, one is particularly struck by the fact that our sturdy forefathers attached far more importance to property than to life; hence, as might be expected, fire insurance was practised here long before life assurance was thought of. From the

fact that coinage of Canute, Harold, Hardicanute, Edward the Confessor, and other Saxon kings was minted in Bristol, it must have been a populous centre for a considerable period, and naturally must have often suffered from the ravages of fire. In November 1702, the Common Council of this city revived an old order requiring every Alderman and Councillor to keep six leather buckets in his house for the use of his neighbours in case of fire. The churchwardens of the several parishcs had, on their part, to provide ropes and ladders for use in time of need. You will observe that the officials of these early fire brigades were of a distinctly good social standing, and it also shows how the danger of fire was dreaded in the necessarily narrow streets of a fortified city, where most of the houses were built of wood. The Council also bought a new brass fire engine at a cost of £8 15s., and a further expenditure was made on leather buckets, presumably to supply water to the aforesaid engine. These elaborate precautions did not, however, abolish fire; and in 1718 a number of the leading merchants guaranteed a fund of £40,000, and so formed the Crown Insurance Fire Office, and the room in which the directors met, and for which they paid a rent of £4 per annum, is still in existence at St. Peter's Hospital. It may also interest you to know that the charge for insurance of house property was fixed at sixpence per pound on the annual rental, so that our forefathers certainly avoided the error of commencing with too low a tariff. However interesting this subject may be, I must leave it and come at once to the business of the Federation, and here, gentlemen, we may well congratulate ourselves with no uncertain sound as to the growth and unity of the association we represent. It is a happy augury for the future that each President is enabled to speak with increased confidence of the work we are doing, and with more certainty of the realisation of our future hopes. There is this wide difference between a President of an Institute and the President of the Federation, that whereas the former has to give an address at the commencement of his labours, the latter can only give it at the close of his career, when

"something attempted, something done, has earned a night's repose." I should like first to speak of the unity which has characterised our working, and made the past year's work a real pleasure. All our arrangements have been unanimous, and I do not recollect a single meeting where there has been any divided counsel. This is the more remarkable as we are a progressive body, and while it is easy for men standing still to keep shoulder to shoulder, it is not so easy when the movement is a forward one, and all are animated with an intense desire to make the advance a success. From the secretary's report you will see that we are rapidly growing, and the greatest possible impetus has been given by the introduction of examinations and the granting of certificates. Without that we might have degenerated into a series of centres for social intercourse only, but when, as we know, chief offices take special notice of those who have distinguished themselves in these examinations, and that a real solid reward awaits those who have proved their ability, the movement becomes at once instinct with life, and the training-ground of those who are in earnest to succeed. The present subjects show a wise selection, and although advice has been given to alter the curriculum, it would be difficult to improve on the present list. For instance, it has been suggested that botany and photography be added to the list and chemistry withdrawn. I need scarcely criticise these ideas, as you will at once see their weak points, but one incident with regard to the latter subject is well worthy of note. An iron steamship was sent on a voyage laden with a cargo of zinc filings. She met with very bad weather, and the heavy seas having penetrated her hold and saturated the cargo, generated sufficient heat to cause the loss of the ship by fire. Now, I would ask if it would be possible for anyone without a knowledge of chemistry to have detected the danger in such a combination. Each constituent was practically fire-proof, and only a chemist could have foreseen the possibility of that which actually did occur. You will have two most important subjects for your consideration on this occasion. The first is the proposed Orphanage scheme, which it is hoped may now

cease to be merely a scheme and become a reality. It is more than strange that officials whose chief work is to induce others to prepare for future contingencies should themselves have delayed forming such a much-needed organisation. It is certainly not from indifference, as the correspondence on this subject abundantly testifies, and if you consider the assistance promised is sufficient for a start there is no doubt that such a scheme, once realised, would be vigorously supported. The next is the admission of the colonial and foreign Institutes to our Federation. As far as the Colonies are concerned, we have all been deeply touched by their active sympathy during a trying crisis. We might have reasonably expected their good wishes, but that they themselves should give of their best and bravest with a hearty and spontaneous burst of loyalty when the Empire was not in any serious peril shows that ties of kinship exist which must and will make the Greater Britain a happy consummation in the near future. War happily passes, but the ties that bind business men in various countries to common interests all tend more to that enduring unity which present events indicate than even fighting side by side against a common foe. There are a few points I would like to suggest for future consideration of the Federation which may be worthy of note. For instance, could not the Institutes which form the Federation be more in line as to constitution and membership? At present one Institute at least admits managers only; another admits all ranks; another has several grades of membership with corresponding subscriptions. One has an age limit; another has none. One admits agents; another does not. Doubtless different localities require modifications, but at present we have to face this anomaly—that a gentleman who may be a member of an Institute in one place might not be considered eligible if he removed to another locality. Personally, I would prefer a levelling down process in preference to a levelling up, as that would lead to the greater good for the larger number. Then I would suggest the formation of a good central insurance library that would supply books on loan to the various centres, so that certain rare books might

be obtained that it would be impossible for a small Institute to procure in any other way. This would also prove a valuable boon where there is any difficulty in forming classes. I would also call attention to the fact that many valuable papers given at our winter lectures are lost, as it is impossible to have them all inserted in the insurance press. Many Institutes wisely print their papers each year, but others cannot meet the expense. Would it not be possible for two or more of the smaller Institutes to combine their papers and share the expense? You cannot expect an expert to prepare a difficult paper requiring time and thought if it is not to be heard of after the night on which it is delivered. Then there is the question of finances. No work can be adequately carried out without sufficient funds, and it may be advisable to invite well-wishers to become patrons of the Federation, which would certainly prove one source of income. Your excellent "Journal" has been sold hitherto at cost price, and I hope this will continue as far as Institute members are concerned; but should not the number of cost-price copies be limited to a fixed number for each Institute, to be supplied to members only, so that others may pay their full share? These are merely suggestions, which may or may not be of value for future consideration. I thank you heartily for the kind attention you have given me, and hope that our present deliberations will result in such wise decisions as have already been crowned with such marked success.

The Reports of the Educational and Publications Sub-Committees were submitted and resolutions passed in matters of detail regarding them. The Report of the Examiners was also submitted, and the following gentlemen were appointed Examiners for the ensuing year:—

J. H. Boocock ......*Commercial Union* ....Birmingham.
C. D. Butler ....*Royal Exchange* ....Birmingham.
Saml. Butler ......*London and Lancashire* ......Dublin.
John G. Boss ......*Royal* ....Newcastle.
A. Blair ....*London and Lancashire* ......Glasgow.
J. P. Eddison ......*North British & Mercantile*...Leeds.

James Haslam ......*Employers' Indemnity* ....Nottingham.
T. B. Miller ....*Guardian* ....Manchester.
Jas. Ostler ....*Northern* ....Manchester.
C. R. Quinton ......*Norwich Union* ....Norwich.
J. B. Roberts ......*Sun Fire* ....Leeds.
Alfred A. Taverner..*Northern* ....Bristol.
James Wardle ......*Liverpool & London & Globe*...Leeds.

The following Report by the Executive on the proposed Insurance Clerks' Orphanage scheme was submitted :—

PROPOSED INSURANCE CLERKS' ORPHANAGE SCHEME FOR THE INDOOR SALARIED OFFICIALS AND CLERKS OF COMPANIES CARRYING ON THE BUSINESS OF FIRE, LIFE, AND MARINE ACCIDENT OR EMPLOYERS' LIABILITY INSURANCE IN THE UNITED KINGDOM AND IRELAND.

In accordance with resolution of the Conference at Leeds last year two circulars were prepared, one addressed to the secretaries of the various Insurance Institutes and the other to the head offices and branch officials of the insurance offices whose names appear in the *Post Magazine Almanac*, 1899, under the list "Who's Who." The former circular asked that steps be taken to obtain from the membership an expression of opinion as to the amount of support that would be given by the rank and file of the profession in each district, and the latter made a direct appeal to those whose names could be obtained. Both circulars, which were despatched on 10th November, were accompanied by a copy of the proposed constitution. Ten copies of the former and 2000 copies of the latter circular were sent out.

Intimation was received from the Manchester Institute, the Manchester Association, and the Insurance and Actuarial Society of Glasgow that, owing to the existence of ample provision in these centres for the families of deceased clerks, no official support could be expected from them. From the other Institutes the names and addresses of promised supporters have been received as follows :—

Birmingham, 24 names, subscribing £90 15s., of which life members, £75 12s.,
£15 3s. per annum.

Bristol,	90	names,	subscribing	£50	,,
Newcastle,				£9 2s.	,,
Norwich,	54	,,	,,	£24 14s.	,,
Nottingham,	35	,,	,,	£15 6s. 6d.	,,
Ireland,					
Yorkshire,	64	,,	,,	£28 1s.	,,
Others,	71	,,	,,	£49 2s.	,,

The total amount of annual subscriptions definitely promised therefore amounts to £191 8s. 6d., to which must be added the life members as above, £75 12s., also special donations promised towards initial expenses, £7 7s.—in all, £274 7s. 6d. Many others have promised substantial support as soon as the Orphanage scheme is fairly started, its office-bearers chosen, and its rules drawn up. In some instances the subscriptions have been actually paid, and they have been handed over to the honorary treasurer of the Federation, who has kindly consented to take charge of them in the meantime. The six life members reported from Birmingham subscribe on the condition that benefits of the Orphanage be extended to the families of recognised insurance brokers; but it is intended to make such extension.

It may be desirable to remind delegates that

1. The Orphanage will be registered under the Companies Acts, and therefore controlled by the Memorandum and Articles of Association.
2. The liability of members is limited to 5s. beyond their subscription. Subscribers incur no liability.
3. It is not proposed in the meantime to build, purchase, or rent a building for the purposes of the proposed Orphanage, but grants will be made for each orphan on the funds, who will be boarded at such school as may be selected by the Committee.

As the proposed Insurance Clerks' Orphanage scheme is still in embryo, the promised support must be considered

satisfactory, particularly as insurance companies have not been communicated with. Under these circumstances it is for the Conference to decide as to the place where the Articles of Association shall be registered, and the officials to be approached for the appointment of office-bearers, particularly the President and (numerous) Vice-Presidents, also to elect a Provisional Committee to incorporate the Orphanage.

It was decided that the Conference for 1901 be held in Glasgow on the invitation of the Insurance and Actuarial Society of that city, and Mr. David L. Laidlaw of the North British and Mercantile Insurance Company, Glasgow, was unanimously elected President for the year 1900–1901.

The examination papers for 1900 are printed at the end of this volume, together with a list of those who passed in 1899 and in 1900.

*** *For all statements made, and opinions expressed, in the papers in this volume, the respective writers are alone responsible.*

FELT HAT WORKS.

PART I.

WHILST Hat Manufacturing, as an industry, is only one of the smaller factors which go to make up that vast aggregation known as British Commerce, I venture to think there is hardly another trade subject which could be put forward possessing a stronger interest to the individual. The reasons for this are many and obvious. We all wear hats, and this is one of the few rules which has no exception. The custom of wearing some kind of head covering is probably coeval with the world's earliest days. Further, the hat has held an important position in man's attire for ages, as by its particular shape, quality, or trimming, the rank or social position of the wearer was denoted; and does not this custom obtain more or less even to-day in naval, military, and ecclesiastical circles, and also, in a lesser degree, in the different grades of lay society? Then, again, historians, philosophers, authors, and poets have all given attention to the hat. Think of the regard with which the Roman slave would receive the hat which history relates was given to him as the badge of his freedom. An American philosopher, I judge he was a philosopher by the clearness of his reasoning, opined that if Absalom had worn a hat, it is very certain his hair could not have become entangled in the branches of the fatal oak. Oliver Wendell Holmes must surely come under this category, and he lays down that "the hat is the vulnerable point of the artificial integument. The hat is the *ultimum moriens* of respectability."

Tom Hood found in it food for the display of humour, as thus—

> "The Quaker loves an ample brim,
> A hat that bows to no salaam,
> And dear the beaver is to him
> As if it never made a dam."

Robert Burns wrote of

> "A ten shillings hat, a holland cravat,"

and on another occasion

> "Ye are rich and look big, but lay by hat and wig
> And ye'll hae a calf's head o' sma' value."

Shakespeare, you may remember, has said that "the fashion of a doublet, or a hat, or cloak, is nothing to a man," but here he seems to be at issue with history, for in the twelfth century we read that the hats of the nobility were made of velvet, variously coloured, and decorated with gold and jewels, a practice which doubtless gave rise to the remark found in *Timon of Athens*, "Let your head be the only jewel put in your hat." In Queen Elizabeth's day the dandies had a very busy time indeed in following the constantly changing fashions in head gear. Stubbs, in his *Anatomie of Abuses* (1585), quaintly writes:—

"Sometimes they use them sharp in the crone, parking up like the spire of a shaft or steeple, some more some less as please the fantasies of their inconstant minds. Other some be flat or broade in the croune like the battlements of a house. Another sort have rounde crownes, sometimes with one kind of band, sometimes with another, now black, now white, now russed, now redde, now greene, now yellow, now this, now that, never content with one color, or fashion, two daies at an end."

Such a state of affairs gives full point to that line of Shakespeare's,

> "He wears his faith but as the fashion of his hat."

In this same reign a writer thus expressed his appreciation of the home-made article:—

> "The Spaniards constant to the block,
> The French inconstant ever;
> But of all *felts* that may be felt
> Give me your English beaver."

In the time of Charles I. much attention was given to this article of dress, but when the Puritans came in power the shape of hats underwent a radical change, and smart headgear was at a heavy discount.

It was at this point in history that a rhymster wrote :—

> "So Britain's monarch once uncovered sat,
> While Bradshaw bullied in a broad-brimmed hat."

This particular hat, by the way, was shot proof, and is still to be found by the curious in the Ashmolean Museum, Oxford.

The investment in a new hat about this time seems to have been rather a serious matter from a monetary standpoint, as Pepys, in his diary under date of 27th June 1661, writes:— "This day Mr. Halden sent me a beaver which cost me £4 5s. 0d."

On the opening sitting of the Reformed Parliament, the Duke of Wellington is reported to have said, "I never saw so many shocking hats in my life."

And now, coming down to the early part of the present century, I have derived much amusement and interest from a pamphlet published by a then celebrated London hatter, who offered his clients thirty-three different styles of hats, gave illustrations of twenty-four of them, and in sixteen instances supplied essays on the persons the respective shapes had been designed to suit.

Let me reproduce just one essay by this trade tractarian on *The Eccentric Hat.*

"*Unique* in its way, strongly embodying the name in its *form*, this hat is particularly recommended to gentlemen (and many are to be found) who hold their understandings libelled by acting, thinking, speaking, or dressing, like *other men;* but, it must be observed, that slender persons with dark countenances, and about the middle size, best become these hats; for however eccentric a man would wish to appear by adopting any *peculiar* mode of dress, he can never hope to succeed unless nature has done a *little* for him. It follows then, of course, that a tall or short man, if he be stout and well grown, with a fine open florid countenance, cannot cleverly become an *Eccentric;* but an agreeable contortion of the eye, a trifling disagreement in the symmetry of the shoulders, or a slight *bias* of the body *right* or *left*, are indescribable advantages in giving full effect to this hat, which may be worn a little on one side, with a gentle inclination over the eyes, unless they are playing at cross purposes, in the event of which it must be thrown quite back, to give effect to their *playful humour.*"

And now, gentlemen, your patience shall be taxed no longer with references to hats in the abstract. It would be easy to fill the evening with episodes of the past. Ours has been but a

steeplechase from one point to another, with no attempt at continuity, and of course no suggestion of completeness. Perhaps enough has been said to justify the premise that the hat is, and has been for centuries, an interesting and important article of attire, and we will now endeavour to detail how it is manufactured at the present day.

PART II.

The tendency to centralisation noticeable in many industries has a strongly marked example in Felt Hat Works, as comparatively few are to be found outside the districts of Denton, Hyde, Stockport, and Bury, all in the adjacent counties of Lancashire and Cheshire, where probably ninety per cent. of English felt hats are made.

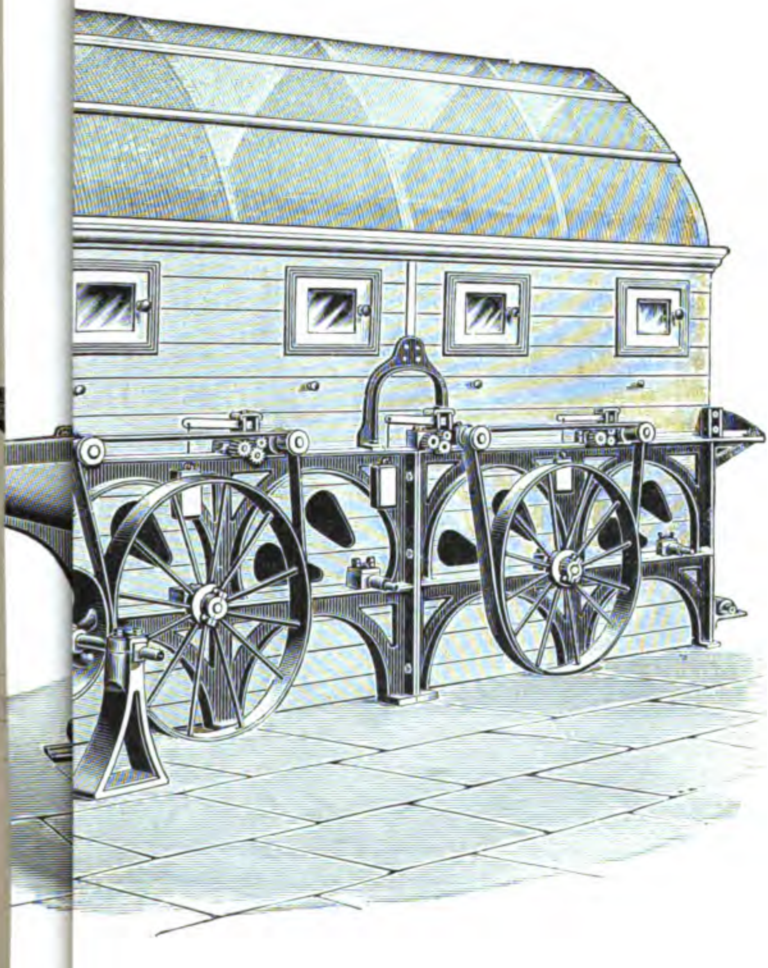
Two qualities of hats are made—the one from fur, the other from wool. In the initial stages the processes differ according to the material used. Fur cut from the rabbit and hare skin is produced largely both at home and abroad. The British rabbit provides the finest fur, and less valuable qualities come from Australia, New Zealand, France, Belgium, and Germany.

Fur.

Fur cutting is a trade entirely separate from hat manufacturing, and we need not therefore refer to it in detail, as the fur comes to the hat manufacturer in paper bags, generally of 5 lb. weight, ready for blending. For this purpose several qualities are mixed or blended, what might be called hand mixing, and the mixing is then passed through a

Mixing

Machine, to open out and mix the furs. This machine you will see illustrated in Fig. 1. It consists of a feed-table fitted with an endless band or apron, which carries the fur to a pair of fluted metal rollers, through which it is fed on to a picker roller (a roller set with short metal teeth), then it is caught by a brush (a roller fitted with rows of bristles), which discharges it into the wooden chamber shown on the left of the figure.



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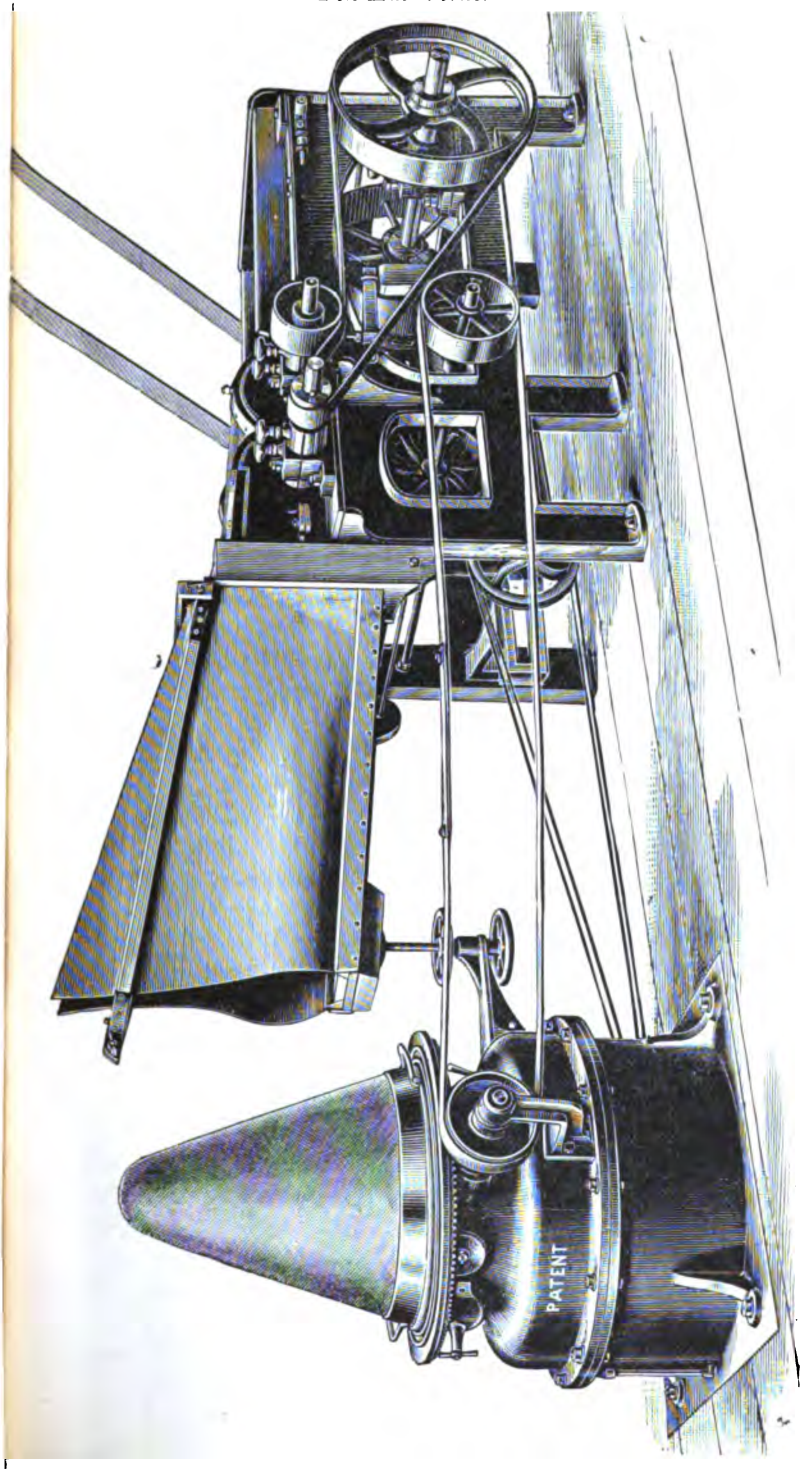


Figure 3. Fur Former.

(John Turner & Sons, Hatters' Machinists, Denton.)

Blowing

follows, the object being to further open out the fur and separate from it "kemps," a growth cut from the skin which does not contain felting properties, and "pelts," which are small bits of skin cut away along with the fur.

A Picker and Blowing Machine is shown in Fig. 2. It has a wood casing, with perforated metal top. The upper part of the machine is divided into several compartments by wood divisions (in the one illustrated there are eight), each compartment being practically a duplicate of the other. The fur is placed on the endless apron shown projecting on the left-hand side. It passes through a pair of fluted metal feed rollers, and is caught by a "picker" roller, which throws it upwards into the first chamber. It drops on to an apron and is carried to another pair of feed rollers, close to which is a picker roller, which again projects the fur into the second chamber. The process is repeated until the fur is discharged at the opposite end of the machine. Each chamber has its separate endless travelling apron, and between each of the several sets of feed and picker rollers there is a slight space, and at this point, by gravity, the waste, gradually separated from the fur by the picker rollers, drops through on to a shaking grid, which throws back on to the picker roller some of the fur accompanying the waste. In the lower part of the machine there is a travelling apron its full length, moving in an opposite direction to the aprons above. On to this the waste falls from the grids, and is brought back and discharged at the feed end of the machine, to be again passed through to recover fur which has fallen through with the waste.

Forming.

The fur is now ready for the Former (Fig. 3), which is fitted with fluted feed rollers, picker roller, and brush, as in the Mixer. There is at one end of the machine an endless feed band or apron, and at the other a discharge spout, opposite the mouth of which latter is a revolving table on which a perforated metal cone is placed, and a fan in connection gives a strong suction current on the under side of the cone. When this set of machinery is put in motion the fur (of which a certain quantity is weighed out) passes from the feeding apron through the rollers named, and

when caught by the brush is thrown down the discharge spout in a cloud which settles on the revolving cone (slightly damped), forming a remarkably even covering. The machinery is then stopped, a wet cloth is wrapped round the cone, a metal cover passed over it, and on immersion in a tank of water the natural felting properties of the fur are such that the coating of fur in the shape of a "form" can be safely rolled back off the cone, and is ready for the next process, Hardening.

Wool.

We must now turn to the preliminary processes in Wool Hat Manufacturing. Wool Washing, Drying, Body Forming, and Hardening is an extensive trade of itself, the forms or bodies being supplied to hat manufacturers at this stage. We will, however, assume that the work of forming is done at the works under consideration.

Forming.

To carry out this process it is necessary the wool should be passed through an ordinary Carding Engine (Fig. 4), which contains a metal-clad carding cylinder, over which the wool passes, and is taken off by a small doffer cylinder. Coming from this in a sheet or web, it is spread by the person in charge on a double cone, revolved by four rollers on which it rests (these rollers and the cone are shown to the right in the illustration). When a sufficient quantity of wool has been spread on the cone, it is severed from the supplying web and cut down the centre, two wool "forms" being the result.

From this point it will not be requisite to describe fur and wool hat manufacturing separately, the processes being to a large extent identical. As a general principle, however, it may be said that there is more hand work in the manipulation of a fur hat than in one made of wool, and where distinctions are necessary I will endeavour to indicate them.

The primary object of the hatter at this stage is to develop the felting properties of the material, and for this purpose moisture, heat, friction, and pressure are required.

We therefore pass to the

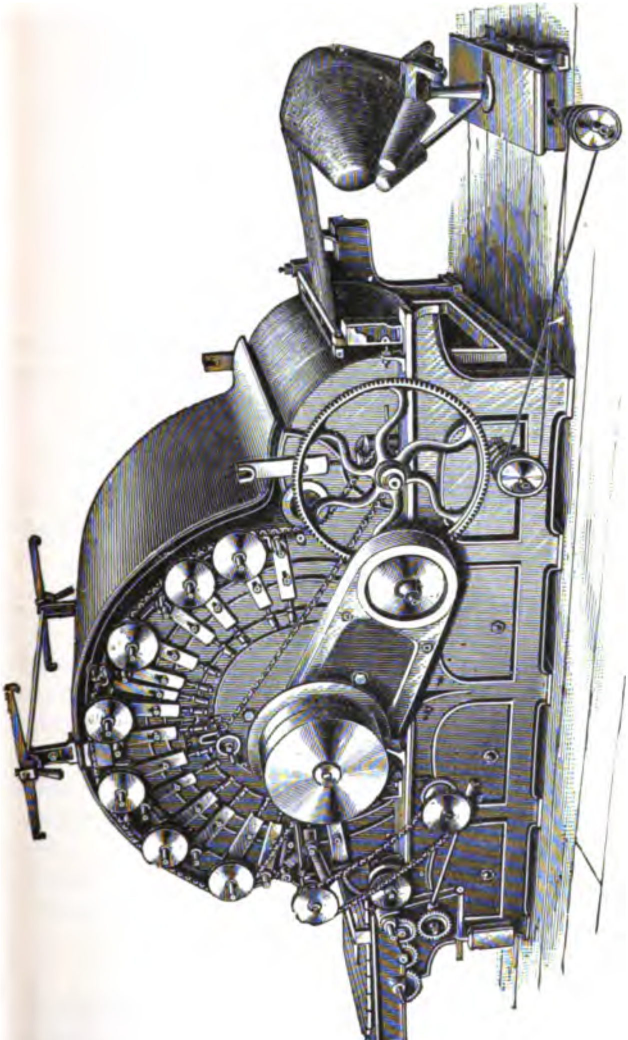


Figure 4. Wool Carder and Former.

(John Turner & Sons, Hatters' Machinists, Denton.)

Hardening

process, which, for wool forms, is accomplished by two kinds of machines. Fig. 5 shows a Flat Hardener. On the perforated steam-heated table on which the "forms" are placed, the hinged plate over is lowered, and a rubbing motion is imparted to the latter. The "form" is afterwards drawn on to the cone alongside, which has a perforated top, and is also steam heated. The disc shown above it, which is fitted with cloth or canvas, is then lowered, and operates with a rubbing motion on the upper part (known as the "tip") of the crown.

Fig 6 illustrates a Cup and Cone Hardener. The "forms" are drawn over the wood cones, and the cups alongside, which have been heated by free steam, are then lowered on to them, and whilst the cones revolve a rubbing or jigging motion is imparted to the cups. To the right is shown a cup let down on the cone, and to the left a cone is shown, and the cup connected with it is seen in the centre being heated.

Fur forms are hardened by hand by being well rolled, and the operator also examines each form and adds more fur to any thin places requiring it.

Settling,

a process to roughen the wool fibre, is next resorted to. A Settling Machine is shown in Fig. 7. This consists of a small tank (containing water and vitriol), with a plank or wood ledge in front, and over the tank are four wooden rollers (some have elliptical rings, others are grooved diagonally) which revolve two in one direction and two in another. The form is dipped in the liquid, rolled by hand on the plank, and then passed through the rollers, the upper pair of which are lowered by the treadle attached to the machine.

Next comes

Milling or Bumping,

which transforms the "form" into what is known as a "body." Perhaps the most popular machine for this purpose for fur forms is the Belgian Crank Bumper (Fig. 8), which is much more compact than the old style of Milling Stocks or Bumpers, common in Woollen Fulling Mills. The machine consists of a tank for holding water and vitriol in which the bodies are placed, and a

set of cranks, carrying bumps or hammers, acting alternately, bump or beat the bodies, many dozen of which can be dealt with at one time. The Scroll Hammer Bumper is a machine best adapted for wool forms (Fig. 8a), the hammers in this being operated on a different principle, and thereby allowed to drop with more sudden and pronounced force on the bodies in the tank. The bodies now require

Washing Out

to clear them of vitriol, and this can be done in the bumper, or other tanks, when they are ready for

Twisting.

A pair of machines for this purpose are represented in Fig. 9. Contained in a circular iron casing are four serrated wooden rollers, which are smaller at their middles than at their ends; and whilst the centres of the two lower ones are fixed those of the two upper ones, at the delivery end only, oscillate. The wet wool bodies are fed in at one end of the machine, and pass out at the other, the object being to still further reduce the size and complete the felting process.

The body in its progress through settling, bumping, and twisting, whilst becoming gradually thinner and firmer, has also been reduced in length and width materially; and now follows

Planking, Stretching, or Stumping,

which is carried on at the planking battery. This consists of a kettle or pan, steam or fire heated, surrounded by a wood ledge or plank inclined towards its centre, round which the hatters work. The body for this purpose is dipped in the kettle, for wool containing only water, for fur vitriol is added, laid on the plank, rolled and then measured (a wood rolling pin and a hatter's measuring stick are used). If found too large, it is again dipped and rolled, at the same time the bottom of the flat (folded) body is made straight and regular. I can best convey an idea of this process by saying that the edges of the flat body must be made straight and even, one with the other, the size reduced by dipping and rolling to what is required, and the felt whilst this is being done is also equalised in thickness. The edges of the wet wool bodies are pared at the battery with a knife to make them even.

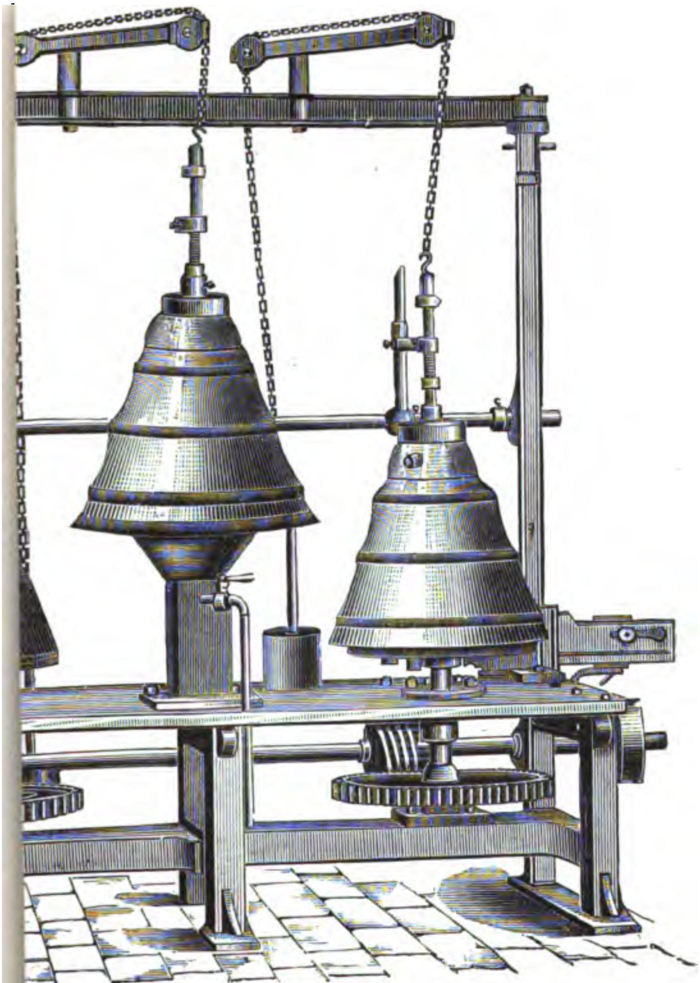
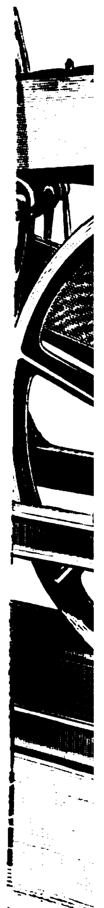
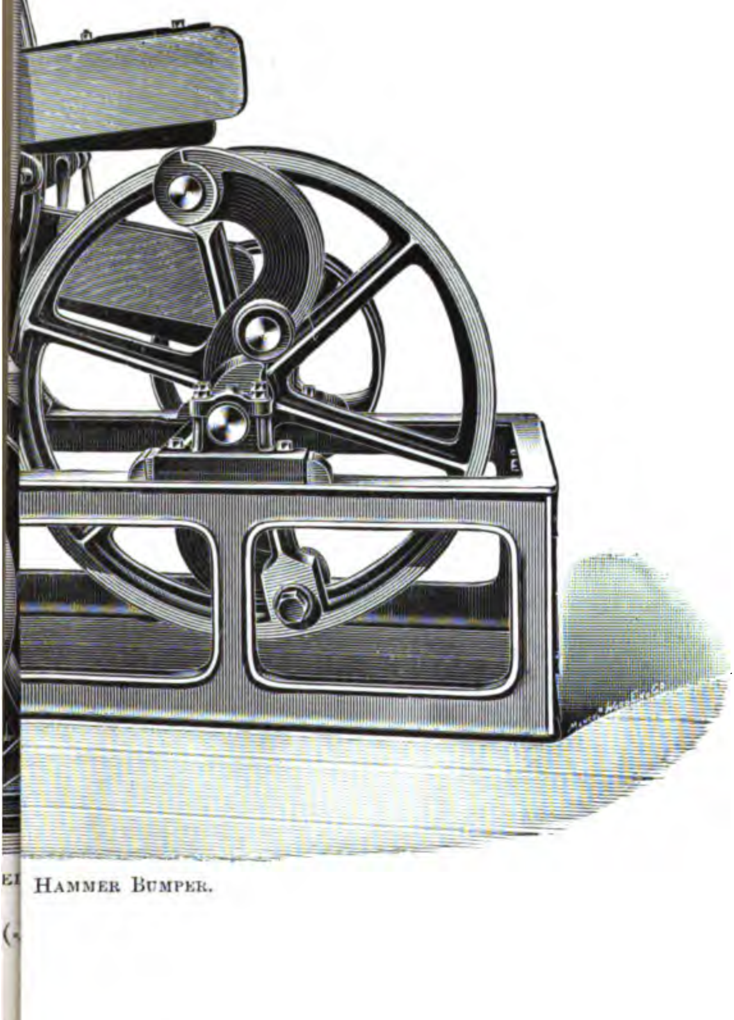


Figure 6. Cup and Cone Hardener.



HAMMER



ER HAMMER BUMPER.

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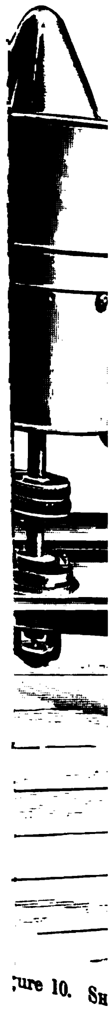

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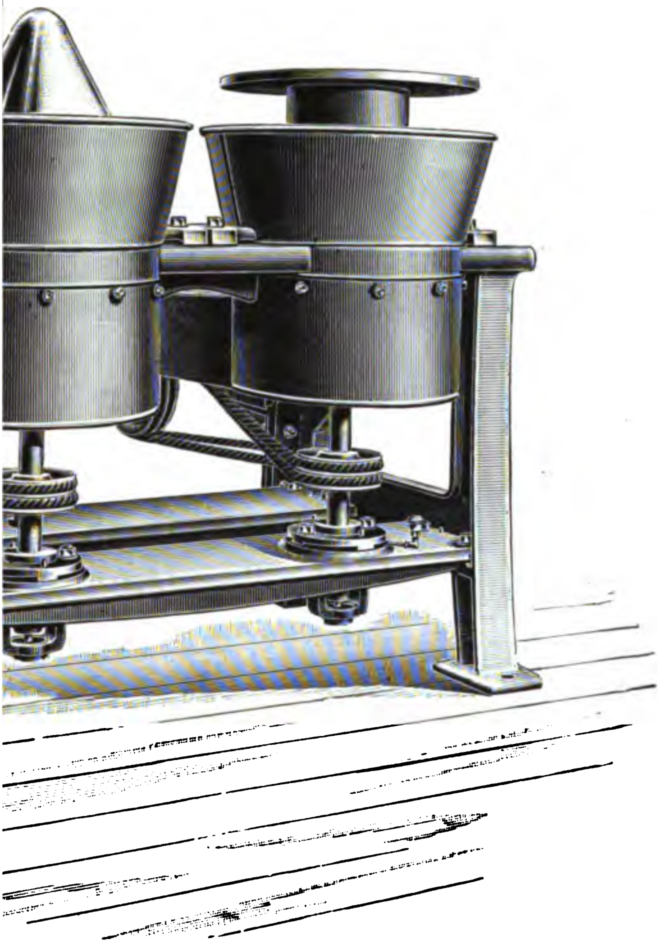


ure 10. SHAVING LATHE.

In case of furs, with the same object in view, a second process is gone through, also at the battery, called second sizing. The processes are entirely hand ones. Machine Planking has been introduced, but only to a relatively limited extent at present.

WHIZZING.

The bodies are now placed in a Hydro Extractor or Whizzer to remove moisture. This is simply a circular iron casing, surrounding another perforated metal casing, mounted on a spindle, in which the bodies are laid, when it is revolved rapidly, and by centrifugal force the water is expelled.

SINGEING.

Fur bodies whilst in the wet state after planking and whizzing are singed by being taken in hand and passed through a gas jet to remove superfluous fibres.

PLANKED BODY DRYING

succeeds for what may now be termed the planked bodies, which are taken to the drying stove, probably the boiler-house fitted up with racks, the boiler supplying the heat necessary, where they remain for a period of about six hours. After drying, it is possible to detect any burrs or hard particles of felt there may be present in the body, and the bodies are examined and any such pulled out, this being called picking.

The bodies after drying require

SHAVING.

One of the latest machines used for this purpose is represented in Fig. 10. On the left you will see a circular iron casing, inside which is a cone mounted on a revolving spindle; on this cone the body is drawn, and when the spindle is set in motion glass-paper is held against the body, thus shaving the surface of the felt. On the right is a differently-shaped lathe for "soft" or "frame" hats, the detached block on the left in the illustration being for fitting on this lathe.

The process now reached,

PROOFING,

is a most important one, the object being to convert the soft body into a stiffened hood. There are two kinds of proof. For wool hats waterproof is generally used, composed of water, shellac, resin, borax, and certain gums, and the ingredients are "let down" (melted) in steam jacketted pans. Fur hats are treated with a spirit proof, which contains, in addition to certain of the foregoing drugs, methylated spirit. No heat is necessary for mixing this latter, the ingredients being placed in a revolving barrel and rolled for several hours, when the mixture is ready for use. In the Proofing Shop the liquor is contained in tanks or pans, in front of which is fixed an inclined wood ledge or plank. The portion of the body which will eventually be the brim is first dealt with, as this requires to be harder than the crown. The operator immerses it in a strong solution of proof, then, laying it on the plank, scrapes it with a wooden scraper, and the proof which is not absorbed by the felt runs back into the tank. A second operator with a weaker solution of proof then deals with the crown in like manner.

The bodies now require

STEAMING,

and are placed on skeleton iron frames contained in a large box, into which steam is injected in order to drive the proof well into the felt.

PROOFED BODY DRYING

follows in what is called the proof stove, which is heated by an iron stove or kiln. This compartment is fitted up with racks on which the bodies are placed, and they remain here about ten hours. After drying, the embryo hat is known as a "hood." It is once more steamed, and then

BRUSHING

is resorted to for wool bodies to remove dirty matter and free the nap, thereby enabling the dye to better penetrate. One style of brush is shown in Fig. 11, it being simply a bristle brush mounted on a lathe spindle, against which the hood is held.

Figure 11. Brushing Lathe.

(John Turner & Sons, Hatters' Machinists, Denton.)

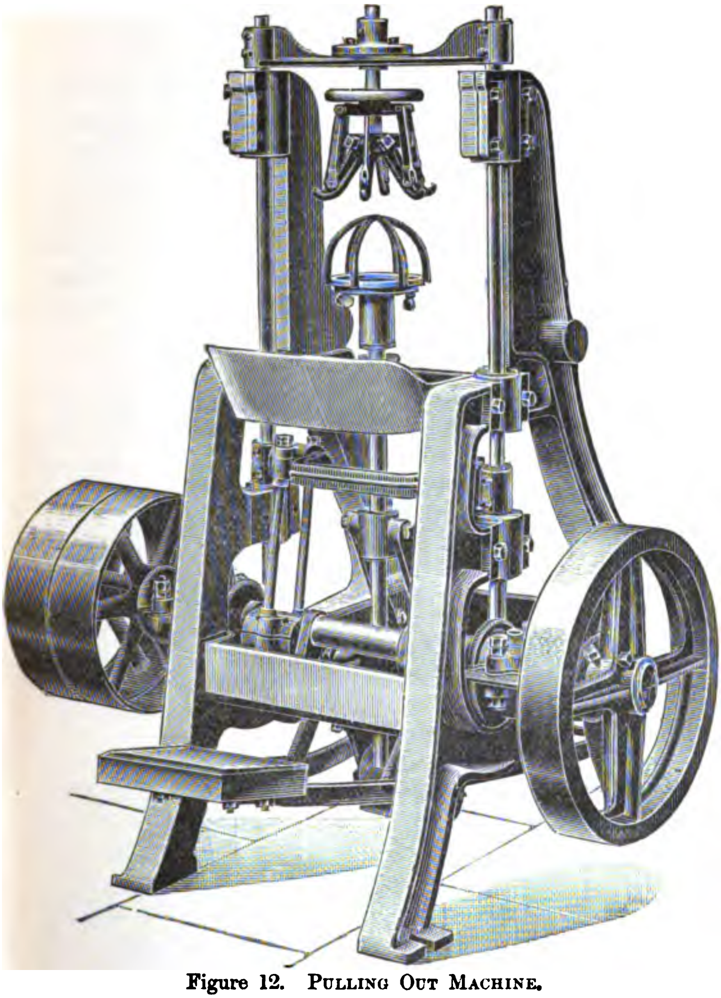


Figure 12. Pulling Out Machine.

(John Turner & Sons, Hatters' Machinists, Denton.)

Clearing,

a process for preparing the surface of the hoods to take the dye, is now necessary, and consists simply of their immersion in a mixture of hot water and borax.

Pulling-out

follows, the object being to equalise the thickness of the felt, and also prepare it for receiving the dye. This is largely done by hand at the blocking batteries, but Fig. 12 illustrates one of the machines used for this purpose. On the skeleton frame or star there shown, the wet hood is drawn, and then raised into the skeleton cup over, a vertical motion is given to the cup, the ribs of which are movable, and by this means the hood is pulled out or stretched.

Veneering.

A process bearing this name sometimes intervenes here for wool hoods. They are immersed and moved about in a tank, or planking kettle, or revolving barrel, containing hot water, into which a quantity of loose fur has been thrown, and these floating particles naturally adhere to the hood, thus forming a thin coating of fur thereon.

Chroming

is a further process for preparing the hood for dyeing, the nap being freed by immersion in a mixture of hot water and bichrome.

Dyeing.

We now arrive at the Dye Shop, where, in ordinary open boilers set in brickwork, fired under, or, as is most common, in steam-heated cavity pans, the dye is prepared in which the hoods are dipped, and afterwards washed out in cold water. Logwood, French madder, aniline, fustic extracts, and other dye stuffs are used. Sometimes the hoods are then dried in the stove, but in the great majority of cases they pass at once to the

Blocking Shop,

where at the blocking batteries, which are duplicates of the planking batteries already described, the dyed hoods are first

dipped in hot water, then drawn over a solid wood block, well pulled down, a string tied round level with the bottom of the block, the felt below this string being well flattened out by the blocker, and forming the brim of what is now a hat. The blocked hat is whizzed again. Fig. 13 represents a new form of whizzer for this special purpose, from which you will see the hats are fixed in oval openings set at equal distances round a circular iron frame. This is set in motion, and when as much moisture as possible has been extracted, the hats are taken out once more for drying.

Blocked Hat Drying

may be done in the stove in which the planked hats are dried (if a separate one is not provided), and probably six hours may be required to dry the hats, when they may or may not be sent for

Singeing

by being taken in the hand and passed through a gas jet to remove superfluous fibres before passing to the

Finishing Shop.

We have here a generic term to deal with, which is often used to include softening, pressing, finishing, rounding, and curling. We will take the processes *seriatim*.

Softening

is first necessary, either in a steam or gas-heated oven. A gas-heated softener is shown in Fig. 14, the gas jets being under a metal shelf or plate, on which the hats are laid in order to prepare them for

Pressing.

Fig. 15 represents one of the hydraulic presses, with accumulator alongside, used for the purpose. In the centre of the table there is shown an oval opening, in which a metal mould or dish is placed. Inside this the softened hat is laid, the brim is protected with a thin metal plate (brim plate), the adjustable cover above the table carrying a rubber bag is then lowered, and hydraulic pressure applied, when the bag fills up the inside of the hat, and applies a pressure up to 400 pounds to the square inch.

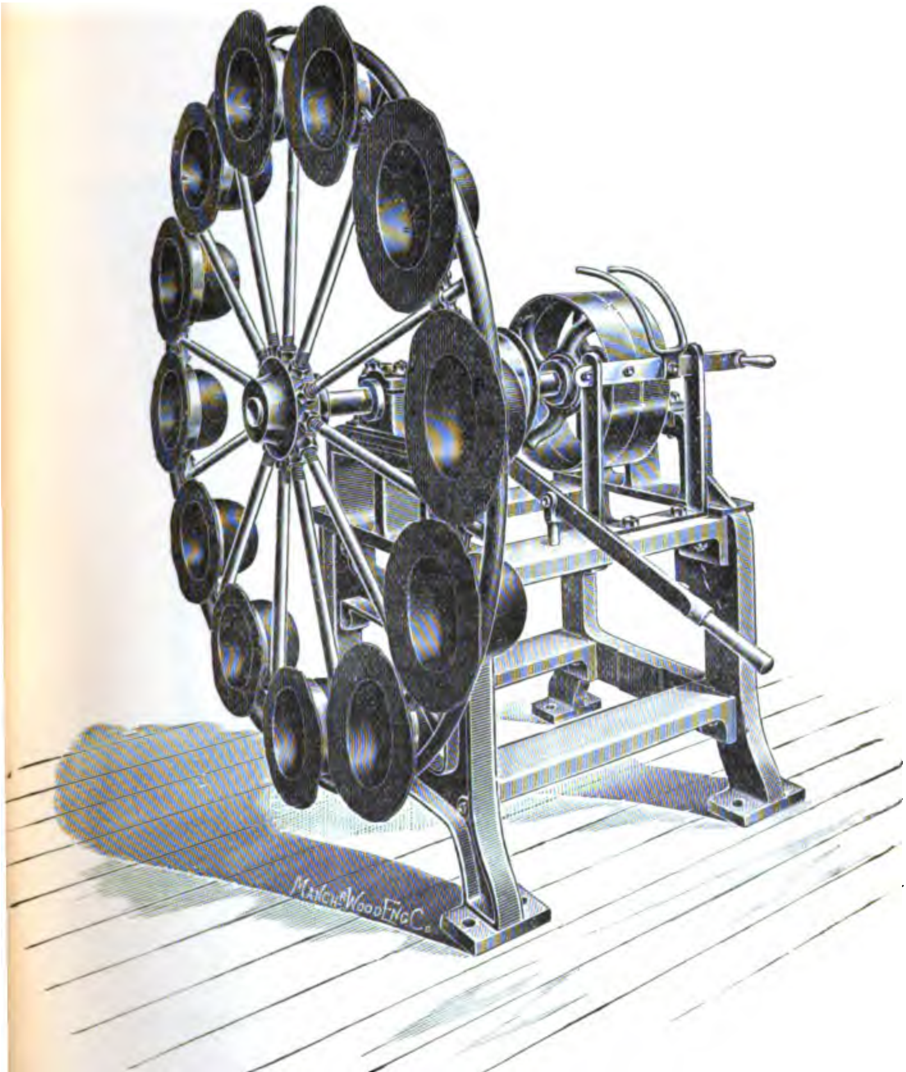


Figure 13. BLOCKED HAT WHIZZER.
(JOHN TURNER & SONS, HATTERS' MACHINISTS, DENTON.)

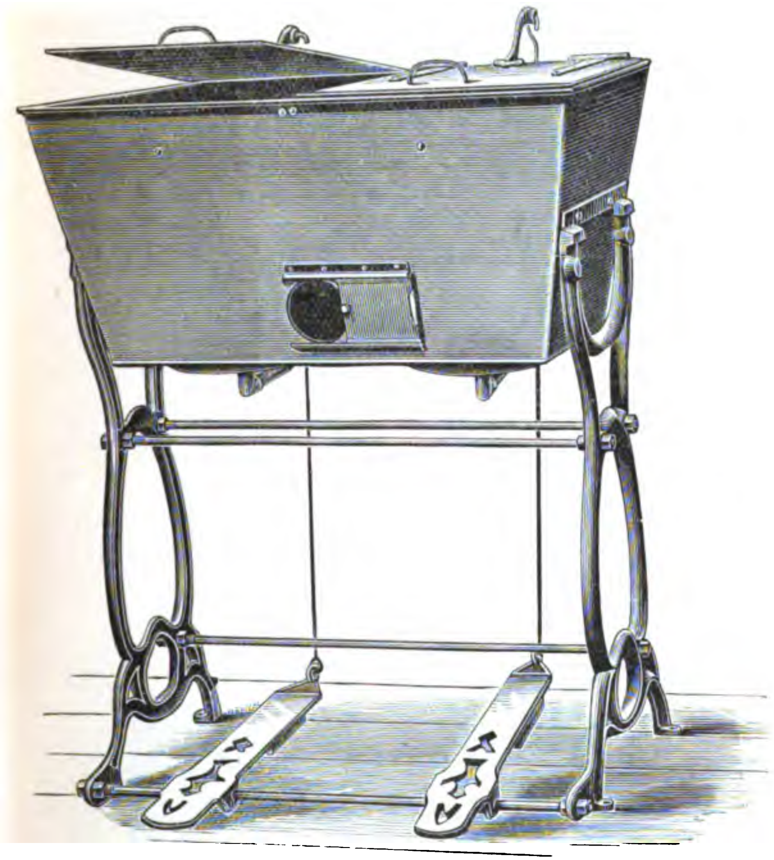


Figure 14. GAS-HEATED SOFTENER.

(JOHN TURNER & SONS, HATTERS' MACHINISTS, DENTON.)

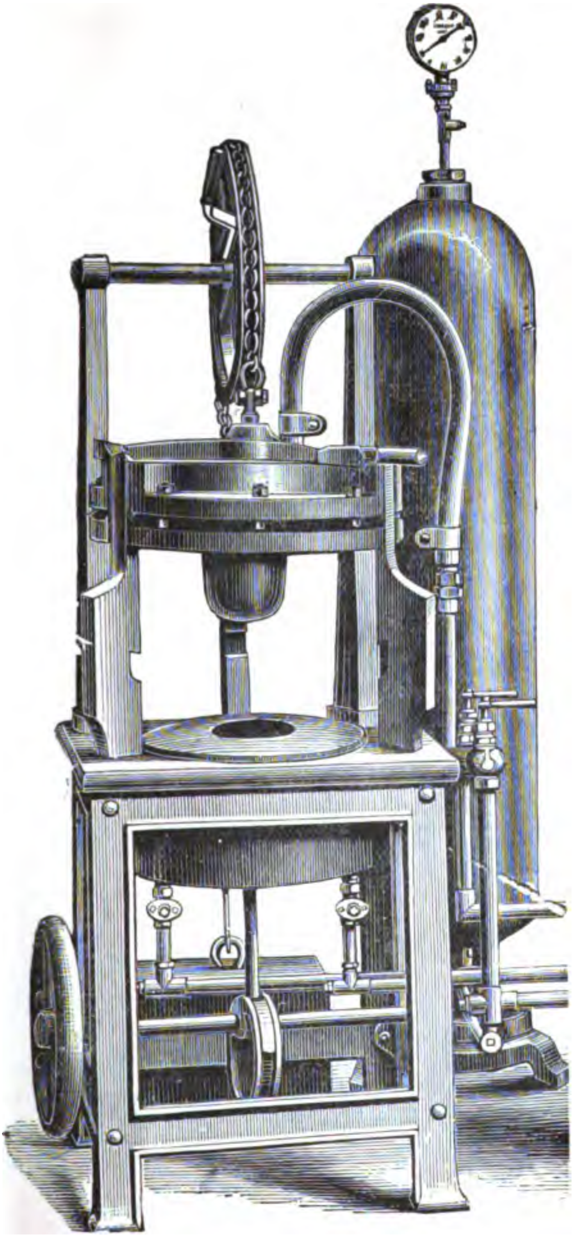


Figure 15. Hydraulic Press and Accumulator.

(John Turner & Sons, Hatters' Machinists, Denton.)

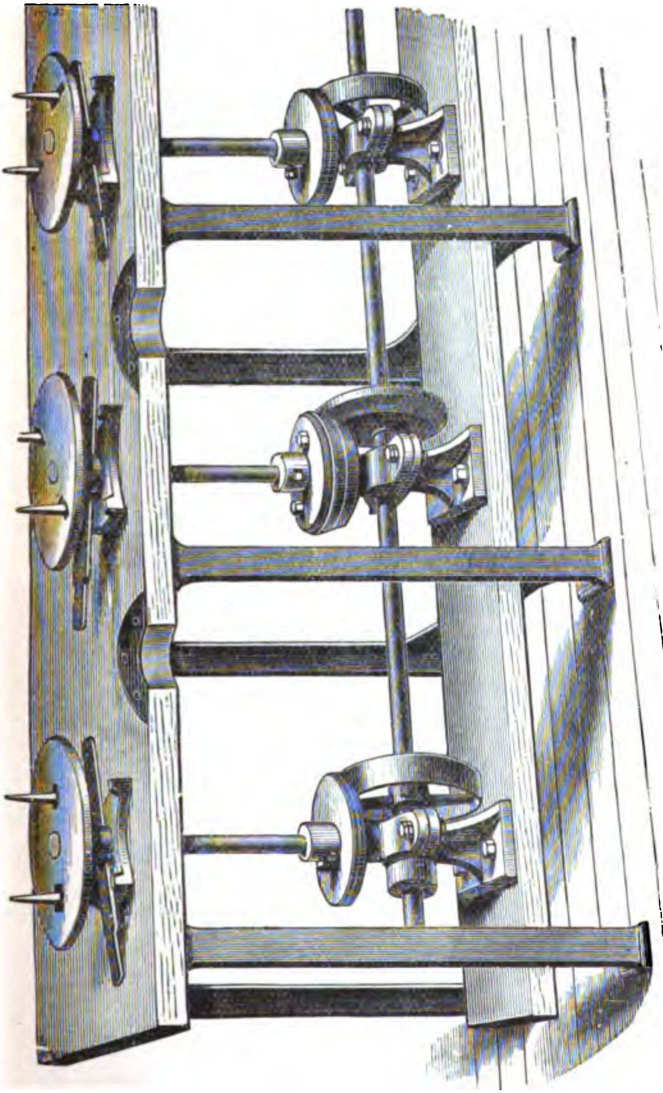
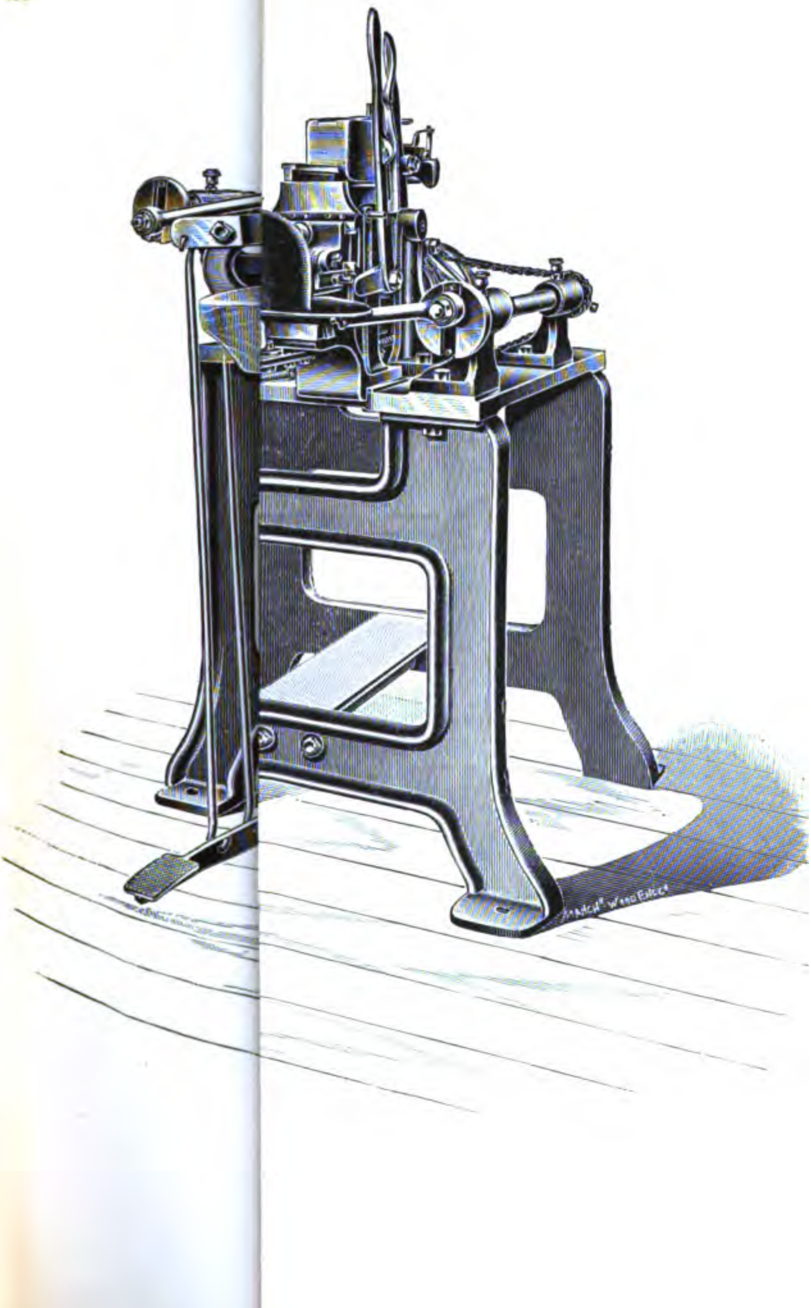


Figure 16. Finisher Bench and Lathes.
(Jonh Turner & Sons, Hatters' Machinists, Denton.)


MATCH & WOOD ENG.

The hat is then taken out of the press with the crown adapted exactly to the shape of the particular mould used, and with the brim made uniform in thickness but not altered in contour.

Finishing.

We now turn our attention to the Finisher's Bench, on which are a number of lathes which Fig. 16 illustrates. On the circular revolving lathe shown, having projecting studs or pegs, a wooden block is mounted, the pressed hat is fixed on this, and glass-papered by the operator, both while in motion and stationary. It is then taken off the block, and the under part of the brim treated likewise, being rested on the edge of the bench for this purpose. Two most ingenious machines have recently come into use for this process. Fig. 17 represents a Brim Finishing Machine. In this the hat is held and moved round by two cone friction rollers, whilst pads faced with glass-paper are held against either side of the brim by two reciprocating arms. Fig. 18 illustrates a Crown Finishing Machine. The hat is mounted on a wooden block, which in turn is given a rotary elliptical movement and a horizontal transverse movement, whilst a reciprocating arm is brought in contact with it, on which is a pad faced with glass-paper, and by this means the whole surface of the crown of the hat is operated on by the pad. Both are automatic, and set to knock off when they have finished their work on a hat. I can hardly hope to give a clear idea of the action of these two ingenious machines, and must leave much to your imagination, assisted by the illustrations, which fortunately show both in duplicate, standing and whilst working. By means of these machines, or the hand work previously named, the rough surface is removed, and the hat is then veloured, and thereby given a fine surface or finish.

Velouring.

The velouring pad is made of moleskin stuffed with cotton waste, and for each hat a little pure fat is laid on the top plate of the stove, from where it is taken up by the pad, with which, in its greased and warm state, the hat is dressed, being mounted on the finisher's lathe for the purpose, alongside which is the gas stove referred to. (See Illustration.)

The brim afterwards wants

Rounding or Cutting,

in order to bring it near the required width. A Rounding Machine is shown in Fig. 19. The hat is fixed on a circular bracket or table, its position being regulated by a slide or graduated scale, according to width of brim required, and a pair of edged discs simultaneously move the hat round and cut off the superfluous brim, under the guidance of a man in charge.*

Pasting.

The edge of the brim is then pasted with what I may call a varnish made of shellac dissolved in methylated spirit, the object being to obtain additional strength in this part.

After this the brim of the hat is softened to prepare it for

Curling and Setting.

This is done in another hydraulic press, illustrated in Fig. 20, with steam baker alongside, underneath which are shelves with stock of split frames for use in the operation. The press is fitted with a table, having an oval opening, round which a curved plate or split matrice frame, the shape of the curl desired, is laid. The hat, after having the brim softened on the baker, is rested on this with a thin metal plate covering the brim, the adjustable cover of the press carrying a rubber bag is brought down, and when pressure is applied the brim is not only set, but the edge turned round or over, forming the "curl." This turned-over part of the brim (which is eventually bound) needs

Paring or Shaping,

in order to make it quite even. The work was formerly solely done by hand with a chisel and miniature plane. Now, however, by the machine shown in Fig. 21, the major part of the paring process is much more quickly accomplished. A metal guide, with

*Cuttings and subsequent parings are not allowed to rank as rubbish. They are sold for the purpose of recovering therefrom the shellac absorbed by the felt at the time of proofing. Such waste from fur hats is, I am informed, also largely shipped to America, where it is treated in such a way as to remove the foreign matter introduced in the felt during manufacture, and the felt is then ground, the result being that it is once more possible to use the product mixed with new fur.

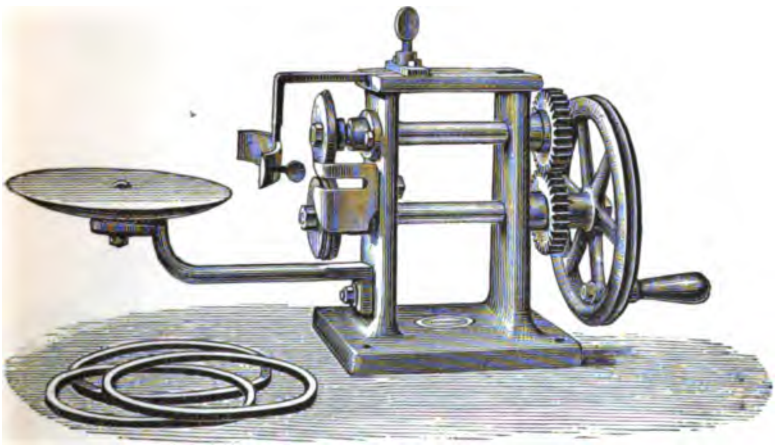


Figure 19. Rounding Machine.

(John Turner & Sons, Hatters' Machinists, Denton.)

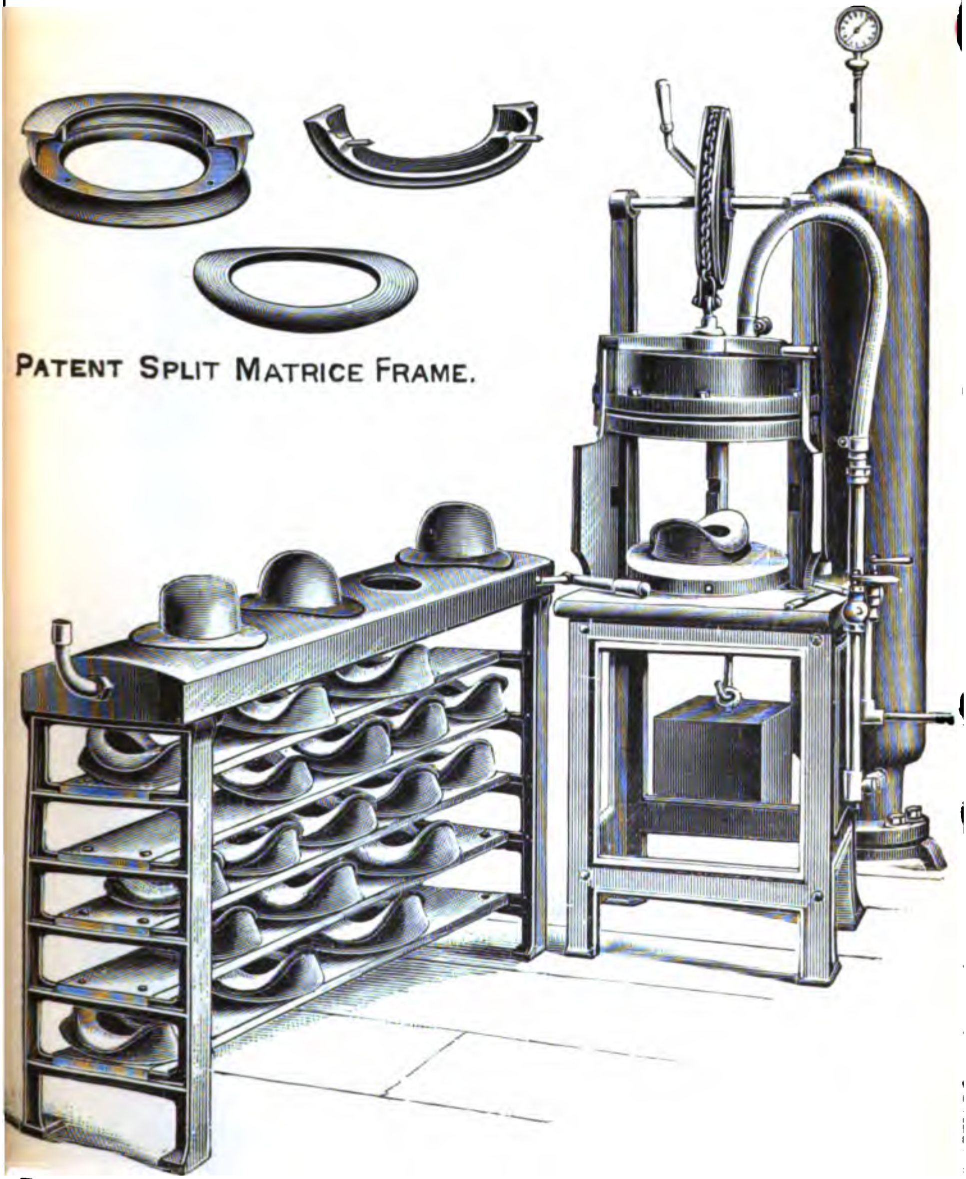


Figure 20. HYDRAULIC SETTING AND CURLING MACHINE, ACCUMULATOR, AND STEAM BAKER.

(JOHN TURNER & SONS, HATTERS' MACHINISTS, DENTON.)

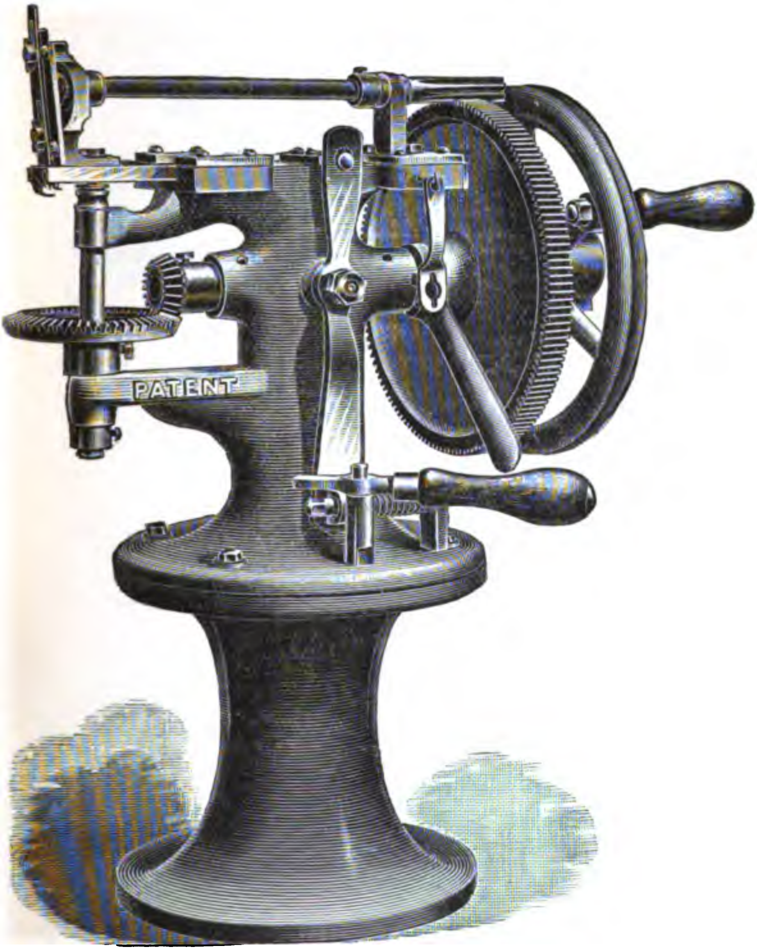


Figure 21. PARING MACHINE.

(JOHN TURNER & SONS, HATTERS' MACHINISTS, DENTON.)

Gas Stove for Warming Pads.

With Top Raised for Heating Irons.

(John Turner & Sons, Hatters' Machinists, Denton.)

milled edge, is fixed on the brim of the hat, which is brought in contact with a milled disc in the machine. When set in motion the pair of cog wheels shown revolve the milled disc, which in turn operates on the guide, whilst the large-sized cog wheel through the top connecting arm or shaft works a small reciprocating knife, which cuts off superfluous felt as the hat moves round.

Wiring.

After paring, an endless band of wire is placed under the turned back edge of the brim, and this has to be made the exact set and shape of the brim, the intent being to strengthen that part of the hat which bears the most strain when in use. Sometimes in place of wiring a stronger brim is made to stand the wear and tear this part of the hat is subject to.

Perforating or Ventilating.

If the hat is to be ventilated, it is at this stage punched with the perforations with which we are all familiar.

The hat is now passed to the

Trimming-room,

given over entirely to the fair sex, the only part of hat manufacturing which is. Here is the giving-out room, where all the trimmings required for a hat are kept and supplied to the workers, who carry on the operations of Banding (sewing on the hat band), binding the edge of the curl, whereby the wire before referred to is enveloped, lining the hat, and sewing in the leather band. The linings are made up before being placed in the hat, in which work sewing machines are used, otherwise the operations are principally done by hand. As you are well aware, many hats are not lined, and labels are often placed in these by the manufacturer for his clients. To a limited extent hats are now cork lined, this lining being attached with a solution of rubber and naphtha, probably made by those who use it. In what part of the works this lining would be done is purely dependent on the maker's convenience. The hat is now finished and ready for the warehouse, but in the several handlings it has received since velouring in the finishing shop it has lost some of its smoothness and gloss, consequently it is dressed or veloured once more, with

the pads heated as before named on small gas stoves, and this is often spoken of as Louring off, then wrapped in tissue paper, placed in a box, and packed in wood crates ready for dispatch to the maker's clients.

In this survey of the processes a hat goes through from the raw material to the finished state, I have not referred to any particular works; you would not indeed expect to find all the plant named in any one place. As regards the machinery used in hat manufacturing, my list must be considered as anything but a complete one, although it is only within the last fifty years that it has become largely a machine in place of a purely manual industry. During that time inventions successful and otherwise have been introduced in bewildering numbers. In this department my best thanks are here given to Messrs. John Turner & Son, Hatters' Engineers, Denton, who placed at my disposal an unlimited number of figures, from which those reproduced have been selected.

PART III.

In considering Felt Hat Works from a purely Fire Insurance standpoint, it may at the outset be said that with the exception of drying the work carried on does not present any feature of special hazard, as a brief generalisation of the principal processes will show. The amount of Wool Carding and Forming carried on in even a fair-sized works is only comparatively small, and, as already mentioned, it is quite common for none at all to be done. Fur Mixing and Blowing is of necessity very different to the more familiar processes of the same name in Cotton Mills, and infinitely less dangerous. The machines and the nature of the substance under treatment will at once render this apparent. In the Hardening, Planking, Dye, and Blocking Shops all the work is in the wet; the liquids used are entirely non-hazardous, water predominating; and as steam is the more general mode of heating the liquids the fire risk is very slight; even with fires I can suggest no particular danger.

In the Proof Shop the kind of liquid used, water or spirit, is largely dependent on whether a wool or fur hat is being manufactured, and the firm which makes a speciality of one does not often make the other. Artificial heat is not required for applying

proof, so that the Proofing shop presents no special features. It is desirable to secure, if possible, that the ingredients used in waterproof shall only be let down by steam, and not melted by fire heat, which pressure of time, or individual opinion, may sometimes cause to be resorted to. Spirit Proof requires no heat in the mixing or letting down, as when placed in a revolving barrel and rolled for several hours a perfect mixture is secured, the methylated spirit acting as a solvent.

It is self-apparent that it is advisable such products as methylated spirit, shellac, and resin, used in proof-making, should not be stored in any quantity in the main buildings, nor is it the custom to do so.

In the Finishing Shop the machinery before described is to be found, heat (either steam or gas) is used for softening, and small gas stoves, as illustrated, are used on the benches for warming the velouring pads. These gas stoves are not likely, with ordinary care and attention to cleanliness, to create any special danger. I think, however, it would be a simple and desirable precaution to lay the velouring pads on the finisher's iron lathes when work ceases, as if a spark happened to be attached to one at the moment it was laid aside, and caused the pad to smoulder away after the works were closed, it would in such a position be less likely to cause any material damage. Ironing of hats by hand is to a certain extent disappearing as a result of the improvements in machinery, but when this is done, and either a brick-built fireplace or an iron kiln for heating irons is used, close inspection of construction and fixing is necessary, as the presence of this feature under the best conditions is objectionable, especially in one of the main buildings of a works, the heat generated being very marked. It is most common, where required, to heat irons on velouring or similar small gas stoves, to which method no exception need be taken. The Trimming-room and Warehouse will both probably contain some of the small gas stoves just referred to, in the former for heating irons, and in the latter for warming the pads. The risk in these particular rooms is practically that of a warehouse only.

I have kept Drying at the end of my summary, as here the most pronounced element of risk is found. There are at least two drying stoves at every works, one in which planked bodies and blocked hats are dried, the other for proofed hoods. The stoves may be of one or two stories, and are fitted with

racks, and when of more than one storey, open flooring. It was customary for these fittings to be of wood, but it is now usual to find stoves fitted up both as regards flooring and racks entirely of metal. It is to be hoped this latter system will in time be universally adopted. For planked bodies and blocked hats, the boiler-house is usually utilised as a stove, the boiler supplying the heat requisite. For proofed hats a separate stove is necessary, heated by an iron kiln or stove with exposed piping running across the room or round the sides, or sometimes it passes below the floor level, and has iron plates or grids over, the object in any case being to secure all the heat possible. Planked, blocked, and waterproofed hats give off nothing of a dangerous nature during the process of drying, and the temperature neccessary varies from 120 to, say, 180 degrees Fahrenheit. Spirit proofed hats require heat, which, I think, will be fairly represented by a maximum of 180 degrees Fahrenheit. These latter during drying give off a vapour (really the methylated spirit liberated by the heat) of an inflammable nature, and only the combination of a sufficiently high temperature or the presence of a naked flame, and a certain amount of vapour, is necessary in order to produce a fire. Such a combination, however, should not be permitted to arise. In all stoves, but in spirit proof stoves especially, the temperature should be watched, and ventilation attended to. They should be of sufficient size to fully meet the requirements without overcrowding. There is an appreciable difference in a stove with ample cubical capacity, and one less roomy and crowded with hats. In the latter the presence of vapour is very noticeable. I would suggest also that it is desirable artificial lights should be kept outside stoves, and that kilns should be fed from and open on to the yard only. Irrespective of all precautions, however, it must be recognised that buildings, constantly subject to heats such as those named must necessarily be susceptible to outbreaks from causes which can hardly be foreseen or entirely guarded against. As a natural consequence all will agree that the structure and fittings of a stove should be of entirely non-combustible materials.

A system of "first" drying whereby the methylated spirit is recovered has been tried to a limited extent. The arrangement consists of a drying chamber constructed of metal and steam heated. At the top is a pipe through which the spirit vapour passes to a coil of pipes in a metal cylinder filled with water. Here it condenses and is run off in the shape of a liquid once more into a receptacle below the cylinder.

In Hat Manufacturing no heavy running machinery is required, neither are the speeds high when we get past the Fur Mixing, Blowing, and Forming Machines, in which the rollers run at about 2000 revolutions per minute; there is, therefore, no particular stress on the buildings, nor is friction in driving, a feature which has made itself apparent. As a consequence, specially strong buildings are not erected, nor are they required for this trade. On the other hand, for the reasons named, many buildings have been "converted" for the trade which are not always so strong and well adapted for their present use as could be desired. Further, there is a tendency in works, old and new, to rather crowd the buildings together, and make communications freely. This is one of the features which militate against this class of risk, as it cannot be denied that thereby an amalgamation of risks, separately, perhaps, not particularly pronounced, is entailed, and we must remember that with the Finishing Shops, Trimming-rooms, and Warehouses either in one building, or two or more buildings freely communicating, the material for a loss of large extent is ever present.

The buildings do not usually exceed three stories in height, and a large percentage of such places do not rise above two stories. Shed buildings are always to be found forming a portion of the premises.

There seems an hereditary trait in this trade to erect odd buildings of timber, the *bête noir* of an insurance man, although it should be mentioned that in these timber extensions moisture is often the prevalent feature, as they are largely only used for wet processes, or otherwise purely as Store Sheds. From the trade point of view I can understand that on the score of convenience present arrangements are satisfactory, and made with method, but I think without material inconvenience changes might be adopted which would result in benefit to the manufacturer so far as his fire insurance is concerned. What I have particularly in mind is that the buildings should be cut off as far as possible one from another, and this seems to a large extent quite practicable by the provision of fireproof doors.

To conclude, I feel sure the deductions arrived at, and the few suggestions made, will not be regarded as arising simply out of a spirit of criticism. Indeed, I am satisfied that all practical hat manufacturers will support the desirability of consideration being given, as opportunity serves, to the points raised. At this stage

of a fairly long and extensive connection with hat works my feeling is that they are improving as fire risks, and will continue to improve, and I have found no body of business men more ready to give courteous attention to any suggestions made for reducing the fire hazards.

JOHN HAWORTH CHAPMAN,
Norwich Union Fire Office,
Manchester.

Insurance Association of Manchester,
December 13th, 1899.

APPENDIX.

HATS, PRICES OF.—After reading the many processes a hat goes through in course of manufacture, it will be a surprise to many, as it is to myself, that they can be obtained, and of good quality, at the prices ruling to-day. The following estimate of the cost of a hat in the early part of this century is enough to make our trade friends sigh for the return of the good old days:—

"Fur used in a hat of fine quality according to the present improved system of making, their proportions, value, cost of manufacture, &c., &c.

	£	s.	d.
FOR THE BODY.			
4 oz. of seasoned Coney Wool, - - - -	0	4	0
½ oz. Red Wool, - - - - - - -	0	1	2
¼ oz. of Silk, - - - - - - - -	0	0	4½
FOR THE COVERING.			
1 oz. primed seasoned Beaver, - - - -	0	8	6
Journeyman's wage for making, - - -	0	3	6
Dyeing, - - - - - - - - - -	0	0	8
Stiffening, Finishing, and Picking, - -	0	1	8
Cost of Lining, finding band and box, - -	0	2	6
Sewing of ditto, - - - - - - -	0	0	6
	£1	2	10½

"The average week's work of a maker is about ten hats, that of a finisher, from five to six dozen."

EXPORTS.—The exports of 1897 and 1898 were as follows:—

	1897.		1898.	
	Dozen.	*Value.*	*Dozen.*	*Value.*
Foreign Countries, -	165,000	£309,000	152,878	£303,190
British Possessions, -	246,000	327,000	262,623	340,254
	411,000	£636,000	315,501	£643,444

FUR.—The following figures were recently given me by a large hat manufacturer as being an approximate estimate of the number of skins required for a year's supply of fur, and the countries from which such are obtained:—

United Kingdom, - - - -	30,000,000
Australia and New Zealand, -	40,000,000
France, - - - - - -	80,000,000
Belgium, - - - - - -	10,000,000
Germany, - - - - - -	40,000,000
	200,000,000

Component Parts.—Other than the "body," the component parts of a hat, such as wires, leathers, cork and silk linings, bands, labels, &c., are bought ready for use by the manufacturer.

Benzine or Benzoline.—Small quantities are kept for cleaning any grease spots on the hats.

Ammonia.—This is used on hats, the surface of which sometimes requires clearing of proof.

Boxes.—Hat boxes are not made at the works, but are repaired at some places.

Crates.—The wood crates are often made and also repaired, but it is very seldom any machinery is used. Occasionally a circular saw is used for cutting laths the required length for making the crates.

Manufacture, Processes of.—The accompanying chart is an attempt to give as far as is possible a concise list of the processes necessary to produce a finished hat.

Fires.—The annexed list of fires may be taken as practically a complete one for the district to which this paper applies. It will be noticed that stove fires largely predominate, and from the amount of loss in such cases the reader will be accurate in concluding that these outbreaks are, with few exceptions, confined to the buildings in which they occur. The larger fires to which special reference is made would, in most instances, have probably been far less serious had communications between buildings been protected by fireproof doors. In more than one case the further progress of the fire was checked by such means.

Fire Extinguishing Appliances.—These are not usually provided.

Trade Organ.—The *Hatter's Gazette*, a monthly publication, is specially devoted to topics of the trade.

PROCESSES IN FELT HAT MANUFACTURING.

FUR.	COMMON TO FUR AND WOOL.	WOOL.
Mixing.		Carding and Forming.
Blowing.		
Forming.		
Hand Hardening.		Machine Hardening.
		Settling.
	Milling or Bumping.	
	Washing out.	
		Twisting.
	Planking.	
	Whizzing.	
Singeing.		
	Drying.	
	Picking.	
	Shaving.	
	Proofing.	
	Steaming.	
	Drying.	
	Steaming.	
		Brushing.
	Clearing.	
	Pulling out.	
		Veneering.
	Chroming.	
	Dyeing.	
	Blocking.	
	Whizzing.	
	Drying.	
	Softening.	
	Pressing.	
	Finishing.	
	Velouring.	
	Rounding.	
	Pasting.	
	Softening.	
	Curling and Setting.	
	Paring or Shaping.	
	Wiring.	
	Perforating or Ventilating.	
	Trimming.	
	Velouring.	

LIST OF FIRES IN FELT HAT WORKS, 1887 TO 1898, BOTH INCLUSIVE.

Date.	Town or District.	Part in which outbreak occurred.	Time of Outbreak.	Supposed cause.	Amount of damage.
1887.					£
February ...	Denton ...	Warehouse	11 a.m.	Spark from Gas Velouring Stove ...	3
March ...	,, ...	Drying Stove	...	Ignition of vapour	20
April ...	,, ...	,, ...	4.30 p.m.	,, ,, ...	50
July ...	,, ...	,, ...	12.40 p.m.	Overheating of kiln pipe	50
July ...	Hooley Hill	,, ...	7.30 a.m.	Overheating of wood racks over boiler	6
October ...	Bury ...	Warehouse and Finishing ...	3.15 a.m.	Not known	15846*a*
November ...	,, ...	Finishing Shop	7.15 p.m.	,, ...	975*b*
December ...	Stockport ...	Hat Stock-room	8.30 p.m.	,, ...	2600*c*
1888.					
March ...	Ashton ...	Drying Stove	4.0 a.m.	Defective boiler flue	45
March ...	Denton ...	,, ...	1.0 p.m.	Ignition of vapour	14
August ...	Hooley Hill	Finishing Shop	8.30 a.m.	Not known	8
November ...	Denton ...	Drying Stove	3.30 a.m.	Ignition of vapour	11
November ...	,, ...	,, ...	11.15 a.m.	Spark from broken kiln	13
1889.					
February ...	,, ...	Warehouse	2.0 a.m.	Not known	1535*d*
1890.					
February ...	,, ...	,, ...	10.30 p.m.	,, ...	90
April ...	Stockport ...	Finishing Shop	2.30 a.m.	Beam built into flue	520*e*
May ...	Romiley ...	Proofing Shop	11.0 a.m.	Not known	9
December ...	Denton ...	Engine House	10.15 p.m.	,, ...	7
1891.					
November ...	Stockport ...	Warehouse and Finishing ...	8.45 p.m.	,, ...	23600*f*
1892.					
November ...	,, ...	Drying Stove	...	Ignition of vapour	3
November ...	,, ...	,, ...	2.0 a.m.	Overheating of wood racks over boiler	126
1893.					
April ...	Denton ...	,, ...	...	Not known	177
October ...	Ashton ...	,, ...	...	Ignition of vapour	73
1894.					
May ...	Denton ...	,, ...	1.30 p.m.	Not known	38
September ...	Stockport ...	,, ...	5.45 a.m.	,, ...	28

List of Fires in Felt Hat Works—*continued.*

D

Date.	Town or District.	Part in which outbreak occurred.	Time of Outbreak.	Supposed cause.	Amount of damage.
1895.					£
November ...	Hooley Hill	Proofing Shop	5.30 p.m.	Man stirring a mixing of spirit-proof liquor, and vapour arising therefrom ignited by gas	10
November ...	Denton ...	,, ...	4.15 a.m.	Not known	1250*g*
November ...	,, ...	,, ...	4.15 a.m.	Fire at adjoining works	22
1896.					
March ...	,, ...	Hat Stock-room	9.0 a.m.	Spark from ordinary fireplace ...	40
May ...	Hooley Hill	Finishing Shop	1.45 p.m.	Paper blowing against gas heater in dinner hour	70
September ...	Romiley ..	Drying Stove	6.0 p.m.	Ignition of vapour	65
1897.					
March ...	Denton ...	Hat Store-room	12.0 a.m.	Not known	80
April ...	,, ...	Drying Stove	10.30 a.m.	Overheating	53
August ...	Stockport ...	Fur Blowing and Forming Shop	7.0 a.m.	Not known	296
October ...	Denton ...	Drying Stove	2.30 p.m.	Proof boiling over whilst being melted on kiln	10
1898.					
August ...	,, ...	Proofing Shop	10.15 a.m.	Not known	22

a Commenced in top story of a three story building, used as Warehouse and for Finishing. An iron kiln or stove was used here for heating irons. Lower floors used for wool washing, carding, forming, hardening, and as trimming store. Entirely gutted; also a communicating three story and cellar building, used for willying, carding, warehousing, and packing.

b Commenced in Finishing, &c., Shop—one storey—buildings mostly not substantial and partly timber. Block in which fire occurred entirely gutted.

c Commenced in Stock and Packing-room, top story of a three story building, to which room the fire was confined. Lower Floors, Body and Trimmings Store, and Finishing Shops.

d Supposed to have commenced in Warehouse in three story building, otherwise occupied as Trimmings Store, Packing-room, and Office. Communicating Building also damaged.

e Commenced in Looking Over, Finishing, and Stock Rooms, part of a two story and attic building, otherwise occupied for Fur Blowing and as Press Shop.

f Commenced in second story of five story building used as Trimmings Giving-out Rooms, Warehouse, Curling, Shaping, and Finishing Shops. Several kilns or stoves for heating irons were used in this building. Block of communicating buildings, greater part five stories high, gutted.

g Fire first noticed in a Shed used as Proofing Shop, partly timber built. Spread from here and destroyed a large portion of premises, which communicated almost throughout.

J.H.C.

THE FIRE HAZARD OF THE MORE IMPORTANT CHEMICAL PRODUCTS.

It was once said by the late Lord Beaconsfield that the prosperity of a country could be judged of with very great accuracy by observing the amount of trade done by it in chemicals. The larger the quantity of chemical substances manufactured, the greater the prosperity, according to Lord Beaconsfield. However this may be, there can be no doubt that the amount of capital invested in this branch of trade is enormous, and that many of the articles manufactured are absolute necessities of everyday life. Without them a very large proportion of what may be called the luxuries, as distinguished from the absolute necessities of existence, would cease, and civilisation be pushed a long way back towards barbarism.

In attempting to consider the manufacture and storage of chemicals, from a fire insurance point of view, one is confronted with the enormous quantity and variety of the substances included under the head of chemicals. The farmer who crushes his apples and ferments the juice is as much a chemical manufacturer for the time as the maker of caustic soda or the producer of explosives. Anything like a complete consideration of the subject, at any rate in the time at my disposal, is therefore quite out of the question. All that is possible is to consider the purely chemical substances which are manufactured on the large scale; and even these must be treated briefly.

Then again, in all large manufactories some source of power is required, and in almost all, the materials require heating before the necessary chemical change can be brought about. Although in some works electricity is employed as a means of driving the machinery, practically steam is the source of power employed in all our large industries. When electricity is used there are fire risks of a special kind to be guarded against; some of these are due to the machinery used for generating the electricity, some

due to defects in the installation. Both, of course, are of great importance, but the consideration of them is outside my present purpose. And even in the case of steam, the risks attendant upon its production and conveyance (*i.e.*, steam pipes) from one place to another will not be touched upon, except, for example, in such a case as when the proximity of a steam pipe is likely to increase the violence of a chemical change, and hence improve the chances of a fire resulting.

Similarly the risks attendant upon the production of means of heating the materials are not, of themselves, relevant to our present inquiry. But as many chemical substances have their activity enormously increased by rise in temperature, and as the relative positions of the source of heat and the vats or other vessels in which the chemical change is taking place is of importance, it will be necessary to touch upon this point in some instances.

Yet again, the particular systems employed in most manufacturing operations have been carried out for so many years without any mishap in the nature of a fire, that one is placed in a somewhat invidious position in venturing to suggest possible sources of danger. It is most surely true that "familiarity breeds contempt," and the chemical manufacturer will smile incredulously when it is suggested that greater care might be exercised about some particular process. The position he takes up is, either that the matter is altogether too trivial, or the possibility of a fire resulting is so remote as to need no consideration. But in this matter it is always "the unexpected that happens," and when a great fire *has* occurred, the unvarying story is that the "cause was completely unknown." Moreover, generally speaking, it is not the great and self-evident dangers which produce fires. These are generally well guarded against, but it is the minor causes which are often overlooked.

In this paper, therefore, it will be my duty to lay stress upon many matters which may, at first sight, appear trivial, but which if not looked after may lead to consequences of the greatest importance and to immense destruction of valuable property.

One of the most constant features of all kinds of chemical change is the production of heat. But it is only in a comparatively few instances that the amount of heat produced is so great as to result in combustion. This only occurs when the chemical union going on is extremely violent. Of course we have every gradation.

Thus, by mixing sulphuric acid with water in varying amounts, we can make the temperature rise 10, 50, or 150 degrees; the greatest amount of heat thus obtainable being many hundreds of degrees below that necessary to the production of flame or even of a low red heat. But by making carbon combine with oxygen, as we do every day in our ordinary fires, we can produce flame; but again, the greatest heat thus obtainable is many degrees below that yielded when hydrogen combines with the same element. In this case, if the proportions are properly adjusted, the combination of the two elements, *i.e.*, the chemical change, is accompanied by explosive violence.

Chemical changes are innumerable and of every degree of vigour. No one can say with certainty before hand how vigorous a particular change will be. All that any chemist can do is to reason that from the known behaviour of certain chemical substances under similar conditions, the substances under treatment will behave in such and such a way. But there is no definiteness about this, and the only way to be sure is to try the experiment. Now, as one result of the centuries of experimenting which have taken place in chemistry, we know that there are various *classes* of chemical elements and substances. Some of these are distinguished by being very reluctant to enter into change, others are less reluctant, whilst others are most active, producing changes even with the first-class that I have mentioned, and when they interact amongst themselves the changes are usually rapid and violent. It is obviously changes of this latter class which produce fires.

One of the elements which would be included in the vigorous class is oxygen—a colourless and odourless gas, and the most abundant substance in nature. It is so abundant that it may be said to be everywhere. More than one-half the weight of the solid crust of the earth is oxygen, eight-ninths of all the water on the globe is oxygen, and it forms about one-fifth of the atmosphere. Its chemical power is also very great, and almost all the chemical actions going on in the world are caused by oxygen. Thus, all cases of ordinary burning are combinations of something, usually carbon, with oxygen. Oxygen brings about the chemical changes which enable us to live, and it also causes our dissolution after we are dead. It is the substance which, from a fire insurance point of view, is all-important. For if, during a conflagration, we could shut off the supply of oxygen to the burning building, the

fire would cease. In chemical operations the purpose is to prepare a new substance by means of some particular change or series of changes, and it is therefore generally vigorous chemical substances such as oxygen which are employed. Although, however, a fire may be *started* by the action of some other chemical substances, it is always oxygen which carries it on, because of the presence of such enormous quantities of this substance in the free state in the air.

Such, then, are the general principles involved in our inquiry, and we will now proceed to consider the matter in detail.

In order to do this we must endeavour to classify the various manufactures in some way. This, however, is very difficult; any arrangement must be very incomplete. But even a rough plan will be of advantage, and I have therefore drawn up the following:—

1. Metallurgical Operations.
2. Alkali Works.
3. Benzene and Allied Bodies.
4. Paint, Varnishes, &c.
5. Explosives.
6. Other Chemical Substances.

By considering these in detail we shall be enabled to deal with most of the important chemical substances manufactured, as well as have a means of reference if desired.

Class I.—Metallurgical Operations.

It is perhaps somewhat doubtful if we can strictly regard the products of metallurgical operations—that is, metals—as fairly coming within the category of chemical substances. But if that criticism has any weight when referring to the more common metals—such as iron, copper, lead, &c.—it certainly has none when the less widely used, but still important, metals—such as sodium, magnesium, &c.—are concerned. These may truly be called chemical products, and have an important bearing upon fire risks, if not from their manufacture, most certainly from their storage and carriage.

Taken as a whole, the operations included under the head of metallurgy do not afford a large number of fire risks of what one may call the more interesting kind, *i.e.*, where the causes producing the fire are more or less obscure. Of course, everybody knows that in the smelting of metals enormous heat is required. This

heat is in many instances the very greatest that human ingenuity can devise, but, as a general rule, extra precautions are taken because of this, and no inflammable material is allowed near or in the works. We may therefore say that the risks are due to the fires themselves, which are purposely kindled, and as these are generally well under control and constantly watched practically few accidents happen. Whatever dangers there are are well known, and can be properly provided for in the rating.

From a purely chemical point of view it is well to remember that metallurgical operations are what are called by chemists "reducing" actions; that is, that the metal is obtained from some compound of it by taking away the constituent or constituents with which it is combined in the compound.

Very frequently the substance smelted is an oxide or a combination of oxygen and the metal, and the smelting operations consist of the withdrawing of that oxygen and the setting free of the metal.

In regard, therefore, to the larger manufactories it will not be necessary to pursue inquiries, but some of the smaller operations will repay a little attention.

The first substances to mention are Sodium and Potassium. These two metals were discovered by Sir Humphrey Davy and are known to chemists as *alkali* metals, because they are the essential elements present in the strong alkalies—soda and potash. They are distinguished as possessing remarkably active chemical properties; in fact, they are regarded as two of the most active chemical elements known. For many years they were simply regarded as chemical curiosities; but later on their strong chemical power was made use of in turning other less active metals out of their combinations, and hence in helping in the manufacture of this latter kind of metal. Both metals are made in the same way—by strongly heating a mixture of the hydrates of potassium or sodium with a compound of iron and carbon known as carbide of iron. The operation is conducted in egg-shaped retorts with removable covers, and the heating is accomplished by regenerative gas furnaces. The distilled metal passes into long, narrow, cast-iron condensers, from which it drops into iron pots containing mineral oil to protect the metal from oxidation. In the case of potassium an explosive compound of the metal and carbon monoxide, which is produced by the chemical change, is liable to form. Special precautions should therefore be taken to guard against

this by avoiding an excess of carbon in the carbide. Sodium is not so dangerous. But it is in the storage of these metals that the great danger arises. If exposed to the air they oxidise, *i.e.*, combine with oxygen very readily and, of course, produce heat. But when moisture is present this oxidation goes on with greatly increased vigour; hydrogen is given off, and this hydrogen is generally ignited—always so in the case of potassium, frequently so in the case of sodium. Consequently, it becomes of the greatest importance to see that these substances should be properly stored in thoroughly dry places, and, preferably, that they should be kept under mineral oil, which is perfectly free from oxygen.

Sodium is employed in the manufacture of magnesium and aluminium, and as an alloy with mercury in treating gold ores for the purpose of dissolving the gold. In the two former cases the sodium is made use of by heating the chlorides of the metals with it. The superior power of the sodium draws away the chlorine from its combination and sets free the metal. Large quantities of sodium are used for this purpose, and its storage and proper handling in such works should be carefully looked after. The manufacture of aluminium is now, however, largely carried on by means of the electric furnace, thus avoiding the use of sodium and cheapening the process.

Before leaving our consideration of the metals it may be as well to point out a general warning; viz., that almost all are liable to combine with oxygen. In ordinary conditions this combination—as, for example, in the case of iron rust—is not accompanied by much heat; but chemical action is always much intensified by causing the bodies to be in a fine state of division, and hence, if we have the metals in a finely-powdered condition, rapid oxidation will go on, frequently resulting in enough heat to cause incandescence. For example, it is a common lecture experiment to make finely-divided iron become red hot by simple exposure to the air. In regard to such actions the presence of a little moisture assists them, and, consequently, it is found that sometimes the fire breaks out only when the parcel of metal has been moistened. The moistening, instead of protecting the material, has simply added fuel to the fire. Several cases of fires arising in this way are on record, and the teachings to be obtained from them should not be lost sight of.

Finely-divided metals are made use of in many operations. Iron filings and steel filings if moistened with a little water mixed

with a little inflammable substance—such, for example, as cotton waste (oiled or not)—and the whole exposed to a warm sun, would quickly develope enough heat to ignite the waste.

"Magnesium powder"—that is, powdered magnesium—is an article of commerce. It is used by photographers for producing the flash-light, sometimes used for photographic purposes, and also as the illuminant in a very powerful form of magnesium lamp. "Zinc dust" is also found as an article used by chemists and some manufacturers.

Class II.—Alkali Works.

This manufacture is certainly the most important of all those usually included under the head of chemical trades. Originally the production of carbonate of sodium was the only object of the alkali-maker; but, gradually, side products were added, until at the present day a very large number of important chemical substances are made side by side with carbonate of sodium, which, although it may still be the product made in the largest quantity, is probably not that which yields the greatest revenue. The history of the alkali trade is a very instructive one from many points of view, two of the most interesting being perhaps that in one plan, still very largely adopted, the processes are essentially the same as those patented by the original inventor, Leblanc, of Paris, in 1791; and, secondly, the history shows us how what were originally waste products—the proper disposal of which was closely regulated by stringent Acts of Parliament—came to be of very great value and a source of considerable profit to the manufacturer.

The compound of sodium, which occurs in inexhaustible quantity in the earth, is sodium chloride or ordinary salt; and hence the problem which exercised the minds of the chemists during the last century—immediately after Duhamel had shown in 1736 that the base of salt and that of soda was identical—was how to convert common salt into caustic soda. Numerous plans were tried, but all more or less unsuccessful, until Leblanc, who was physician to the Duke of Orleans, introduced his process somewhere about 1790. This process, with slight modifications, is still the one by which the greater amount of the carbonate of soda used in commerce is manufactured.

It consists essentially of three parts :—

1. The conversion of the salt into sodium sulphate, by the action of hot sulphuric acid. This is known as the Salt Cake process.
2. The decomposition of the sodium sulphate at a high temperature by means of limestone and coal; known as the Black Ash process.
3. The process of extracting and purifying the sodium carbonate contained in the black ash.

In the first process strong sulphuric acid is poured on the salt which is contained in a large iron pan. A moderate amount of heat is applied to start with, and hydrochloric or muriatic acid gas is given off. This passes from the furnace through condensers, consisting of towers filled with coke down which water is trickling. The water dissolves the acid, and the solution is collected at the bottom of the towers, and forms commercial hydrochloric or muriatic acid. Only a part of the salt is decomposed in the iron pan and by a moderate heat. Therefore, when the first evolution of the acid fumes almost cease, and the mass becomes pasty, it is raked from the pan on to the hearth of the "roaster," where it is heated more strongly; almost to redness. This completes the decomposition, and more hydrochloric acid is evolved. The salt-cake or sulphate of sodium produced is raked out of the furnaces, allowed to cool, and stored in bins until required. Here is a point sometimes requiring attention. There is a tendency to remove the substance from the furnace before it has had time to cool sufficiently, and one has occasionally seen fresh salt-cake lying in the bins so hot as not to be capable of handling. If this should come into contact with woodwork there would be a great probability of charring and, under favourable conditions, of a fire; whilst if the bin of hot material adjoins or is near to bins of other substances which are used or made in the works—such as nitre or chlorate, and which are powerful supporters of combustion—then it is quite possible this hot salt-cake may lead to a very serious conflagration.

It will be observed that sulphuric acid is used in the manufacture; and hence almost every maker of salt-cake is also a maker of sulphuric acid or oil of vitriol. This substance is made in large leaden chambers, where steam, sulphur dioxide, and vapour of nitric acid are made to come together, along with a little air.

Chemical reactions ensue, resulting in the formation of a solution of sulphuric acid, which collects on the floor of the leaden chamber and is drawn off from time to time from the outside. The chambers work continuously, but the acid is not allowed to accumulate in them beyond a certain strength. Above this, action on the lead would rapidly take place and the chambers be ruined.

The sulphur dioxide required in the manufacture is obtained by roasting iron pyrites—a yellow mineral containing a large percentage of sulphur. This substance occurs in small quantities in coal, where it is known as "brass"; and in many cases the heat caused by the oxidation of the sulphur in presence of oxygen and moisture has given rise to the spontaneous ignition of the coal. When in bulk, as in the manufacture of sulphuric acid, the tendency to oxidise is not so great, because the material is not in a finely-divided state, and hence its liability to cause injury is not so great. Care should, however, be again taken with the roasted material from which all the sulphur has been burnt off. This is frequently withdrawn from the ovens before it is cold, and the same danger attends this as does the storage of the fresh salt-cake. No woodwork should be near, and certainly no stores containing nitre or chlorate.

The nitric acid required for the manufacture of the sulphuric acid is obtained by heating nitrate of sodium and sulphuric acid. This is often done by making the heat from the smouldering pyrites warm the vessel in which the nitric acid is being made. The vapour of the acid thus produced passes through flues into the leaden chambers along with the sulphur dioxide. Nitric acid is an exceedingly powerful chemical substance and brings about most violent chemical changes. It is therefore necessary to keep it well away from substances which are liable to undergo combustion, such as wood, &c.; thus no woodwork should be allowed near the pyrites kilns or nitre pots. Also, the addition of any organic matter, such as coal dust or coke, to the sodium nitrate (or "Chili saltpetre" or "Nitrate," as it is sometimes called) should be most carefully guarded against. Moreover, the store of nitrate should be in such a place where it would not be heated or liable to come into accidental contact with sulphuric acid.

Before the mixed gases pass into the chambers they are made to pass up a tower, called after its inventor—a Glover tower. This is made of lead, in the upper parts, of about 22 lbs. per square

foot; in the lower, of perhaps 40 lbs. The lead is lined by thick fire-bricks capable of resisting both heat and strong acid. This lining is stouter at the bottom, where the heat is greater. The height varies somewhat according to the size of the leaden chambers, a common size being about 10 feet square and 30 feet high. The lower part is fitted with hard flint or other similar substance not attacked by hot and strong acids. On top of these flints coke is placed. This could not be used in the lower part, because it would take fire in consequence of the heat and the action of the oxygen in the nitric acid.

The object of this tower is to treat some strong vitriol containing oxides of nitrogen dissolved in it, which is obtained in another portion of the works. It is therefore sometimes called a "denitrifying" tower. The denitrification is brought about by making the nitrous vitriol mix with the ordinary chamber acid and the mixture trickle down through the coke and flint packing. By this plan a double saving is effected; for the nitrogen oxides are set free from the acid and rendered available for use in the chambers, and the chamber acid is concentrated by the heat of the hot gases.

It will be noticed that the coke packing is liable to take fire if allowed to come too near to the hot brickwork and gases at the bottom of the tower; but it is also liable to fire if, from an accident, the supply of acid which is made to run over it runs short. Should this be the case, the coke rapidly dries and ignition will quickly follow. The risks of fire in a Glover tower are therefore of two kinds—firstly, due to improper construction; and, secondly, due to defective working. Both have to be carefully looked after.

After the gases have passed through the leaden chambers, instead of being allowed to go out into the atmosphere, they are made to pass up another tower, known as Gay Lussac's, in order that the valuable oxides of nitrogen which they contain may be extracted from them. This tower is something like the Glover, except that as the gases are not so hot it is less substantially built. The lead of which it is made is thinner and the fire-brick lining also, the latter being sometimes entirely dispensed with. The tower is quite filled with coke, over which sulphuric acid of about 1·75 specific gravity runs. This acid robs the gases of the oxides of nitrogen which they contain, runs out from the bottom of the tower, and is pumped up to the top of the Glover tower, as already described.

The supports of both towers, as well as of the leaden chambers, are usually wood scaffolding and, of course, should be carefully protected.

The acid made as I have described is concentrated by evaporation in open leaden pans up to a certain point and after that by distillation in glass or platinum vessels.

Strong sulphuric acid as well as most other acids is usually stored in glass carboys. If any accident should happen to one of these, and the acid come into contact with wood or other combustible substance, great heat is usually produced and charring takes place. This would not, generally speaking, produce flame, but if any substance containing a large quantity of oxygen, such as nitre or chlorate be present, violent combustion would result. Care should therefore be taken to see that the acid store is at a distance from these substances, and that, preferably, it should have stone or earthen floor.

The Black Ash Process.

This, the second process in the manufacture of washing soda, is carried on in large reverberatory furnaces in which a mixture of salt-cake, limestone, and small coal is strongly heated. The furnaces are very substantially built of fire-brick bound with iron, and the waste heat is generally used for evaporating the solution of the carbonate. An ordinary furnace will work off a charge of about 3 cwt. of salt-cake in about 40 to 50 minutes; and consequently, allowing for charging and discharging, about 25 "balls," as they are called, of black ash will be produced in a day. When the operation in the furnace is completed, the pasty mass is raked out into iron wheelbarrows and allowed to cool. As soon as it is sufficiently cooled to be rigid the masses of brownish-black substance are stacked on stone floors for further cooling.

In place of an ordinary reverberatory furnace, the heating of the mixture of salt-cake, &c., is sometimes done in a "Revolving" Furnace—that is, one in which the bed is made to revolve by mechanical means, whilst the flame from the fire-place sweeps through the centre. In this way it is supposed the mass is more evenly mixed, and the results more equable.

The Black Ash process is generally conducted at a distance from any combustible material, and the fire risks are not great.

THE EXTRACTION OF THE SODIUM CARBONATE.

Before the "balls" of black ash are cold, they are broken up and treated with water in large lixiviating tanks. The solution, after settling, is "carbonated" and then boiled down in iron pans heated by the waste heat of the black ash furnace. "Soda ash" is the calcined product obtained from the boiling down pans. "Soda-crystals" is the material produced by dissolving soda ash in hot water, and allowing the solution to cool, when the ordinary washing soda crystals separate out.

Bicarbonate of soda is made by bringing the soda crystals into contact with carbon dioxide gas. This is done in apparatus of various shapes made of brickwork, wood, or, preferably, iron. In the ordinary mode of working there is not much heat given out by this process, and hence not much danger attaching to it.

In addition to the substances already mentioned a great many other important bodies are manufactured in alkali works. Amongst these are sodium hydrate, bleaching powder, and potassium chlorate.

Sodium hydrate is made by adding lime to the diluted liquid obtained by lixiviating the black ash. The tank liquid must be quite clear and boiling before the lime is added. After the settling of the carbonate of lime formed in the process, the clear fluid, which is now a solution of caustic soda, is boiled down in iron pans. Oxidation is brought about in the boiling down process by adding nitrate of soda to the liquor in the pots.

Caustic soda is usually packed into iron drums directly from the pans. It should be kept well away from any accidental contact with acid, as great heat is produced when these bodies come together, and this heat would be able to start other chemical actions which might produce combustion.

Bleaching powder is made by passing chlorine into brickwork chambers on the floor of which freshly slaked lime is placed. After a little time the chlorine is absorbed and bleaching powder or chloride of lime results. If the temperature rises too high the product is spoilt, consequently the heat is well looked after and kept down. The manufacture of this substance, however, as well as that of the caustic soda, requires the use of large quantities of quicklime, which, as is well known, gives out a very large amount of heat when moistened. The quicklime store should not be kept in a wooden building, or on a wooden floor. The roof should be a good

one, the sides brick, and the floor flagged or concreted. Like the caustic soda store, it is best that the lime should be at some distance from the stores of hydrochloric and sulphuric acids in order that no accidental leakage of these substances may reach it.

Potassium chlorate is perhaps the most dangerous material which the alkali-maker produces, as will be realised when we remember the recent and terribly destructive fire caused by this substance at the works of the United Alkali Company at Widnes. It is made by passing chlorine gas into boiling milk of lime, and then decomposing the calcium chlorate thus formed with either potassium chloride or carbonate. After settling, the clear liquid is evaporated, when crystals are obtained. These are dried on leaden sheets, crushed, and packed in barrels.

Potassium chlorate is not of itself combustible, but it contains such a lot of oxygen in a readily available condition that it forms with sulphur, carbon, and many other bodies, explosive mixtures. Moreover, if it is heated it gives up oxygen, and hence supplies the very substance which bodies require to enter into violent combustion. Acids act powerfully upon it, producing great heat and gases which aid combustion. The barrels in which chlorate is packed are lined with paper; it would be advisable that lead or zinc-lined cases should be used. The chlorate store should be removed from the acids, and as free as possible from woodwork.

Within the last thirty years a new process for the manufacture of carbonate of soda has been largely adopted. This process, which is likely to revolutionise the alkali industry, is known as the "Ammonia Soda Process," or sometimes the "Solvay Process." The chemical change upon which this plan is founded is, that when carbon dioxide gas is passed into a solution of salt contained in dilute ammonium hydrate, the ammonium and the chlorine of the salt combine together and form ammonium chloride, and at the same time sodium bicarbonate is produced, which, being somewhat insoluble in solution of ammonium chloride separates out from the mixture in the solid form. In order that the process may be commercially successful, it is necessary to recover the ammonia from the solution. This is done by heating the liquor with caustic lime.

The whole process differs from that used in the Leblanc system, and particularly in not requiring the use of strong acids. The bicarbonate is converted into the ordinary soda ash by calcining it in a furnace, but apart from this and the lime kilns comparatively

few furnaces are required. Moreover, one of the conditions of success is that the chemical change referred to above shall take place at a low temperature, and hence precautions are taken that the vessels shall be kept cool by streams of cold water running over them. The fire risks are therefore not great. The only point necessary is to notice the large amount of lime used, and to take care that the storage of this substance is properly looked after.

Class III.—Benzene and Allied Bodies.

The third class into which I have ventured to divide the principal chemical manufactures includes what may be called the Coal Tar products.

In the process of gas-making there is formed in the "hydraulic main"—a large pipe partly filled with water, through which the gas passes immediately after leaving the retorts;—two liquids, one, the lighter, containing a large quantity of ammoniacal compounds, and hence called "ammoniacal liquor;" and the other what is known as "coal tar." The ammoniacal liquor is sold to the ammonium salts-maker, and forms the principal source of all our ammonium compounds. The tar is usually treated in separate works by distillation, and a series of products are obtained. From these, by subsequent treatment, many important commercial substances are formed, amongst these being the following:—Benzene and chemically similar bodies, carbolic acid, naphthalene, anthracene, and pitch, and then by further treatment we get aniline and the beautiful series of well-known aniline dyes. Owing to the magnitude of this branch of trade, the various processes here mentioned are frequently sub-divided, and the first rough distillation of coal tar forms a distinct branch by itself. The products which the tar distiller makes are obtained by dividing the distillate into various fractions. Commencing at that which distils over first, we get "ammoniacal liquor," "first light oils," "second light oils," "creosote oils," and "anthracene oils" in the order named; whilst pitch remains behind in the still. An ordinary size for a still is one holding 1200 gallons of tar. It is made of iron and heated by a fire underneath. Of course the whole of the products and the substances used are combustible, and hence great care should be taken to regulate the fire to prevent boiling over, as well as arrangements for charging and discharging the still. For instance, the still should be fairly near the tar tank, and the

supply pipe should be on the opposite side of the furnace door, so that in case of a pipe breaking there should be time to damp out the fires before the issuing vapours reach the furnace. Also the cock for withdrawing the liquid pitch should be at the opposite side to the fire door, so as to avoid the chance of ignition whilst running out the hot mass into the pitch tank.

The light oils are used for the manufacture of benzene or benzol, toluene, and carbolic acid. For this purpose they are first treated with sulphuric acid in lead-lined tanks, then with water, and finally with milk of lime. The carbolic acid is thus separated, and then the benzene and toluene are distilled off by means of steam.

From benzene and toluene several products are made, the most important perhaps being nitro-benzene and aniline. For the former a mixture of sulphuric and nitric acids is made to act upon benzene. Great heat is produced, and a large quantity of nitrous fumes (oxides of nitrogen) are given off. The product is washed with lime water, and then water alone, and then distilled by steam. If pure benzene has been used, and care taken in the manufacture, the product forms what is known as "Essence of Mirbane"—a pure form of nitro-benzene used in perfumery and for flavouring purposes.

Aniline is made from this nitro-benzene by acting upon it with a mixture of acetic acid and iron. From this mixture hydrogen is produced, and this attacking the nitro-benzene converts it into aniline.

Frequently aniline makers are also nitro-benzene makers, and, as will be at once understood, the processes are extremely dangerous. The storage of the "light oils" or naphtha requires great care. The vats or casks should be kept very cool, and away from the stills and mixing vessels, which are apt to become hot by the chemical changes which go on in them. If required to be visited by lights, only safety lamps should be employed. Then, also, the strong acids required should be looked after, and kept away from woodwork as much as possible.

The numerous aniline dyes are made from aniline by the action of different chemical substances. Thus, oxidising agents, such as arsenic acid or lead nitrate, produce magenta or rose aniline, which gives rise to a large number of other colours.

The creosote oils produced by the distillation of coal tar are used for pickling timber, and for making certain kinds of dis-

infectants. Timber thus treated would be somewhat more combustible than in the ordinary state.

The most valuable portion of the coal-tar distillate is the Anthracene, because of the use which is now made of it to manufacture madder colours. A crude product is obtained by simply allowing the anthracene oils to stand, when the solid portions, chiefly consisting of anthracene and naphthalene, separate and are removed by filtering through coarse sackcloth, and afterwards pressed by hydraulic pressure. This crude product varies in quality from 30 to 60 per cent. of pure anthracene. It is sold by the coal-tar distillers to the anthracene refiners, who purify it by hot pressing and treatment with light petroleum. Finally it is passed to the colour makers, who convert it either into "anthraquinone" by oxidation with either nitric acid, or sulphuric and potassium bichromate; or into "chloranthracene." From these substances the dyes "alizarin" and "purpurin" are obtained. So important has the manufacture of these dyes now become that the growth of madder, the basis of Turkey-red dyes, has been almost discontinued, and thus thousands of acres of valuable land are rendered available for the growth of cereals.

The processes of manufacture are liable to the risks of fire already pointed out—viz., those connected with the storage of strong acids and alkalies and chemicals which are powerful oxidisers. There are not so many volatile and inflammable substances, however, in use, and hence the colour-making with aniline is not so dangerous. This, however, is not the case with anthracene refining, which employs petroleum oils, and is best done in a separate building.

The process of dyeing consists in fixing the coloured substance upon the fibre in such a way that it will not easily rub or wash off. In the great majority of cases the colours have no power of combining with the fibre of themselves, but have to be fixed by means of substances called "Mordants." These are of various kinds, but all consist of chemical substances which have the power of forming with the colour an insoluble compound which is precipitated within the fibre. In some cases the methods adopted have led to conflagrations of a serious character. Thus, the too rapid drying or storing of goods dyed with Turkey-red has frequently led to fires. The heat of the stoves should be carefully regulated, and the temperature of the materials watched. Probably the cause leading to these fires is that of oxidation of the

size, grease, oil, or other substance with which the warps are treated. For some colours the "fixing" has to be done by a process of oxidation, and the introduction of salts to bring this about is attended with considerable risk in the subsequent drying unless great care is taken. The temperature of the drying-room should be watched and kept as low as possible, even although this involves a loss of time in passing the goods through. Several fires have arisen in consequence of the neglect of this simple precaution.

CLASS IV.—PAINTS, VARNISHES, AND SIMILAR BODIES.

Generally speaking, the basis of paints is, or ought to be, white lead. With this is mixed the coloured substance until the required tint is obtained. As white lead is incombustible and usually the coloured substance is a mineral colour and therefore also of the same nature, it seems that colour works would be a good risk; but the plan of mixing the materials with oil, and of sometimes grinding them in it, opens up at once the whole of the dangers connected with that substance. The liability of the vegetable and animal oils to undergo spontaneous oxidation is well known and has oftentimes been extensively written upon. This phase of the risk, being present whether the oil is chemically treated or not, does not come into our present inquiry. But for the use of the paint manufacturer the oil is generally treated, and a word or two is necessary in regard to this treatment. The object of mixing the coloured substance with oil is to afford a medium for spreading it over a surface, but it is essential that the oil should dry quickly. This it would not do in its natural state. The oil is therefore "boiled." This so-called boiling, for it is really not boiling at all, is brought about by heating in an iron boiler with constant stirring. The oil rapidly darkens in colour, becomes thicker, and inflammable gases are given off. These are sometimes purposely ignited at the top in order to darken the substance more quickly. Linseed oil thus treated is much more readily oxidised when spread out in a thin layer and exposed to the air. This oxidation constitutes the drying. In order to still further increase the rapidity with which this takes place, certain chemicals are sometimes mixed with the oil. These are called "driers," and amongst the substances used for this purpose are—litharge (oxide of lead), red-lead (another oxide of lead), acetate of lead, binoxide of manganese, sulphate of zinc, &c. The addition of these substances whilst bringing about

the required drying properties, at the same time adds to the possibility of ignition under suitable conditions in consequence of spontaneous combustion.

But there are other risks attendant on paint-making which, although of less importance than those due to oil, are yet present, and as they are somewhat obscure they may possibly be overlooked. These arise from the paints, *i.e.*, the colouring matters themselves.

"Lamp black" is made by burning resin, bone oil, or coal tar, and collecting the smoke in a suitable chamber or in bags. The substance is afterwards partly purified by calcining in iron cylinders. This gets rid of some of the oil or grease, which would otherwise hinder the drying of the paint. But there is frequently a little oil left in, and this small quantity is quite enough to cause, by its oxidation, spontaneous ignition. It is the case of oily waste over again, and several fires have been traced to this cause. The storage of this substance should therefore be very carefully considered and precautions taken against contact with inflammable material and woodwork. It should also be borne in mind that a *small* quantity of water, such, for example, as would be met with in a damp store-room, would act as an aid to oxidation.

The peculiarities of madder colours have already been mentioned. Since they are also used as pigments, the same precautions are necessary with regard to them.

A very favourite and beautiful yellow paint is the chromate of lead, which may be taken as a type of the "chromes." These substances are made from the potassium chromates, bodies which in their turn are made from chrome iron-ore. Both the chromate of potassium and the dichromate, are salts which are very rich in oxygen, and they should therefore be kept away from possible admixture with warm combustible substances. The orange yellow chromate of lead is obtained by adding a solution of chromate of potassium to one of nitrate of lead. It also contains a good deal of oxygen, and both it and the nitrate of lead from which it is made must be carefully stored. In fact, it may be briefly stated that all the chromates are highly oxidised bodies and should be treated accordingly. Several substances used as brown pigments are combustible. Thus *asphaltum* or *bitumen*, originally a mineral product, but now obtained as a by-product in the manufacture of coal-gas, is used to a limited extent; *mummy*, another kind of bitumen obtained from the catacombs; *sepia* and its varieties are combustible; whilst the first-named when dissolved in turpentine is highly inflammable.

Of the blacks, in addition to lamp black already mentioned, there is *ivory black* made by carefully calcining bones; or, very rarely, ivory. This should be carefully looked after, as it is open to the same objections as lamp black, and is probably even more dangerous. These blacks are used in large quantity for the manufacture of printers' ink and blacking, hence precautions ought to be taken in these establishments in regard to them.

Some greens are made by mixing chrome yellow with Prussian blue. Now, the latter substance is a compound of iron with carbonaceous matter, and hence would burn at the expense of the oxygen in the chromate. A destructive fire arising from this very cause is on record, and hence such greens ought to be carefully watched.

Varnish.

A varnish may be regarded as a fluid which, when spread out on a surface, dries to a film which possesses a certain amount of lustre and is impervious to air and moisture. The simplest kind of varnish is that of the solution of some sort of resin or gum in a volatile liquid; but an oil varnish is one which contains an oil in addition to these substances. "Spirit" varnishes, *i.e.*, those of the first class, are the quickest driers, but they are liable to crack; and the addition of the oil, although making them take longer to dry, generally makes them more durable and lustrous.

Several substances are used as solvents—such as methylated spirit, naphtha, turpentine, and, for some of the very high-class ones, ether and chloroform.

The oil most frequently employed is linseed, but sometimes walnut and poppy oils are used.

The "gums" are usually anime, amber, copals of various kinds, shellac, resin, and asphaltum.

The gums are melted and mixed with the heated oil. During this process inflammable vapours are given off, and the whole process is highly dangerous. Before use the oil is generally clarified, and driers are almost always added.

"Japanning" is a form of varnishing in which the end process requires heat. The manufacture should be carried on preferably in a separate building, but at any rate in one where the vapours can be rapidly carried away, and where the pots, if they catch fire, can be rapidly wheeled outside into the open.

Class V.—Explosives.

As a rule, I presume, insurance companies are not *very* anxious to accept the risks of explosive factories, nor even of any building in which they are stored in large quantities; therefore, very little need be said in regard to this branch of chemical manufacture. It is necessary to remember that explosives can be divided into two easily defined classes—firstly, those which consist of mixtures; and, secondly, those which are chemical compounds. The first class consists of substances very intimately mixed together, one or more of which are bodies very rich in oxygen—such as nitrates or chlorates of potassium or sodium; the other material or materials being such as can form compounds with oxygen which are gaseous. The typical substance of this class is gunpowder—a mixture of nitre, charcoal, and sulphur. When ignited the oxygen of the nitre combines with the carbon to form carbon dioxide or carbonic acid gas, and with the sulphur to form sulphur dioxide. Both these substances are gases, and at the temperature at which the ignition takes place are enormously expanded: hence the force of the explosion.

The second class consists of what are known as "high explosives" —such as dynamite, gun-cotton, &c. These consist of chemical compounds of the oxygen-containing body with the combustible, and since in a chemical compound the substances are much more intimately connected than in the most carefully-made mixture, the force of the explosion is usually greater.

In most of these bodies the substance containing the oxygen, that is, the active body is nitric acid or chloric acid.

Thus, *nitro-glycerine*, which is used in making dynamite, is made by acting upon glycerine with the strongest nitric acid; strong sulphuric acid being used at the same time so as to keep the nitric at full strength during the action. *Gun-cotton* is nitro-cellulose prepared in a similar way, but using cotton instead of glycerine. *Picric acid* is made by the action of nitric acid upon carbolic acid. It is of a fine yellow colour and is sometimes used in dyeing; therefore, it should be looked out for in dye-works, as it is a dangerous substance. As an explosive it has not quite enough oxygen, and hence it is sometimes mixed with nitrate or with chlorate of potassium. *Melinite* is said to be simply compressed picric acid; and mixtures of various kinds are in use under fancy names. These high explosives are fired by concussion or compres-

sion, usually brought about by the action of another explosive—fulminate of mercury, which is used in percussion caps.

Class VI.—Other Chemical Substances.

Under this head would be included a very large number of substances not falling into any of the former classes. Only a few of these can be noticed.

"Acetic acid" is prepared by the dry distillation of wood. In this way several different substances are obtained; some in the brown watery fluid obtained in the receiver, some left behind in the retort. The fluid in the receiver which contains the acetic acid is first distilled with lime, when the "wood-spirit" and "acetone," two of the substances, are separated, and the acetic acid, combined with the lime as calcium acetate, remains behind in solution. This is evaporated, when tarry matter rises to the surface and is removed. The calcium acetate is then decomposed by sulphuric acid, which combines with the lime and sets free the acetic acid which is obtained from the mixture by distillation. During the manufacture inflammable vapours are given off, and care should be taken when surveying to see that the arrangements for storage, not only for the acid, but also for the lime, tar, wood-spirit, and acetone produced, or used in the process, are satisfactory.

Acetic acid is used in making paints, varnishes, and white lead; also in treating caoutchouc, gums, &c., and for making acetates for use in dyeing.

"Alum" is made on the large scale for use in dyeing, from "alum shale." This is a kind of clay-slate rock, containing iron pyrites and bituminous matter. This mineral contains the iron pyrites in a very finely divided state, and hence when exposed to air and moisture this substance rapidly oxidises, and sulphate of iron is formed. Great heat is given out by the spontaneous oxidation. This acts on the iron sulphate in the same way as if it were roasted, and the sulphuric acid is expelled and attacks the alumina in the clay, forming aluminium sulphate. After lixiviation and separation of impurities, potassium chloride or sulphate, or ammonium sulphate, is added, and the mass crystallised. In connection with this manufacture it must always be remembered that the "alum clays" or "aluminious schists," from which the alum is made, are liable to spontaneous combustion. Manufactured alum is not combustible.

"Ammonium compounds" are made from the ammoniacal liquor which is made in such large quantities in gas works. They are not of themselves combustible, nor does the manufacture afford points of interest. But I find a statement in a paper, called the "Fireman," saying that the ammoniacal liquor is very good for putting out fires, and has been successfully used for that purpose. If this is the case, one pities the poor firemen, as the ammonia given off from the liquid renders the odour of it intolerable.

In the manufacture of "soap" various kinds of oils and fats are boiled with caustic soda. Almost any kind of fat can be used for this purpose, and therefore the risks of ignition due to spontaneous oxidation of the oils are always present. There is also a danger in some works of a boiling-over taking place. The arrangements of the fires under the boilers should therefore be carefully looked after. A large number of soap boilers make their own caustic soda. This is done in the same way as in alkali works, and the remarks made in regard to those apply, so far as caustic soda is concerned, to these. Before being sold the cakes of soap are kept in a room to dry. This is sometimes warmed artificially, and of course the woodwork becomes very dry after a few years.

Before using the oils or fats the soap-maker and candle-maker generally bleaches them. This is done in different ways, the principle being that the colouring matter shall be acted on by oxygen and rendered colourless. Mixtures of strong sulphuric acid and bichromate of potassium, or of sulphuric acid and binoxide of manganese, or hydrochloric acid and binoxide of manganese, or hydrochloric acid and bichromate of potassium are frequently employed. Of course, a good deal of heat is caused by this action, and the whole process is one requiring the careful attention of the insurance surveyor.

In the manufacture of "glass" and "porcelain" there are very few fire risks, except those of the furnaces, which are intensely hot, but which are usually carefully protected. For some of the operations, however, oxidising substances, such as oxide of manganese, nitre, &c., are required. The storage of these must be regulated with the same care as that used in alkali works for the same substances.

The last manufacture that can be referred to is that of "artificial manures." These are made by treating some insoluble natural substance in such a way that it may become soluble in water, and thus available for the use of the plant. Generally, insoluble

phosphate of lime is made into what is called "superphosphate" by the action of strong sulphuric acid. Bones are also treated with this substance, and thus made more quickly available for the plants when dug into the soil.

The process itself is not one involving many risks, except that a large amount of strong acid is required to be stored, and the precautions for storage before mentioned should be taken in these works also. Sometimes the material treated with the acid is impure, and contains a large quantity of water and organic matter. In such cases enormous heat is evolved by the treatment, and the product is liable to become hot spontaneously if improperly stored. Since it is very difficult to distinguish this product, except by analysis, from a good sample, it is well to fix a rate for the dangerous substance, which would then cover the whole.

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COTTON FACTORIES AND SHEDS.

In fire insurance circles the phrase "Cotton Factories" and "Sheds," the title of this paper, indicates buildings in which weaving is done, in contra-distinction to Cotton Mills, buildings in which spinning and the preparation of cotton anterior thereto are carried on. A factory proper is a building of more than one story in height, containing weaving looms, and although in connection with such a risk there may be buildings (rated under the Cotton Mill Tariff) in which processes other than weaving (such as the preparation of yarn for looms) are done, such buildings are not in the proper sense factories.

Cotton Weaving Sheds, as the words indicate, are buildings of one story in height in which weaving is done, although other processes belonging to the manufacture of cotton goods may, and indeed are, often carried on therein.

Although a building designated a factory must of necessity contain looms, yet all buildings in which processes in connection with weaving are carried on are provided for in rating under the weaving section of the Cotton Mills Tariff.

The cotton trade of this country is the largest of all our national industries, that of agriculture excepted, and the trade is confined almost exclusively to the county of Lancaster, and to parts of the adjacent counties of Chester, Derby, and York, the number of looms in use at the present time being about 670,000.

Cotton Weaving.

Weaving is the art of forming a web or cloth by the intersecting of two distinct sets of fibres, threads, or yarn. The one set of yarns which passes in a longitudinal direction from end to end of the web is called a warp. The yarn which crosses and intersects the warp at right angles is called the woof or weft. The process of weaving is probably coeval with that of agriculture, and its inception is buried in the mist of antiquity. The art in all pro-

bability arose when man had forsaken in a measure the calling of a hunter, had begun to till the ground, and desired other covering than that of the skins of animals.

It is more than probable that the first effort of primitive man in the direction of weaving was in the making of plaited articles, and it has been notably remarked that nations most remote from one another make mats and other articles from fibres of plants. As man advanced netting was developed. Many nations ignorant of weaving plaited and netted, as was noted by Captain Cook among the islanders of the southern seas.

The earliest form of weaving was probably that employed in making mats, such as are now produced by semi-civilised nations. These consist of single and untwisted fibres, arranged side by side to the width required and of the length of the fibres themselves, which are tied at each end to a stick which is fixed so as to keep the fibres straight and on the same plane; the weaver lifts up each of the longitudinal threads and passes under it a transverse one which he first attached by twisting or tying to the outermost fibre of the side he commences with, and afterwards in the same way to that of the other side when it had passed through the whole series.

Weaving is one of the most ancient of the arts, and the textile skill of any race is always a measure of their civilisation and culture, as in its most primitive form its practice implies a certain amount of manual dexterity and mechanical skill. Next to the industries connected with the production of food, the making of textile fabrics is undoubtedly the most important of all the arts, and the patience, skill, and thought devoted to the production of machinery in connection therewith have unquestionably been greater than those applied to any other class of industry.

From the earliest ages the use of the hand-loom has been called into requisition for the manufacture of textile fabrics, some of the earliest examples extant being found engraved on the monuments of Egypt. That the loom was in use amongst the Hebrews in far distant ages we have many testimonies in the Bible, for example, in Job, by some reputed the earliest written of the Holy Books, we have the words "my days are swifter than a weaver's shuttle" (vi., 6). The most ancient of woven fabrics now in existence, so far as is known, are those found made up in the forms of sandals and baskets in the tombs of Egypt.

THE SHUTTLE.

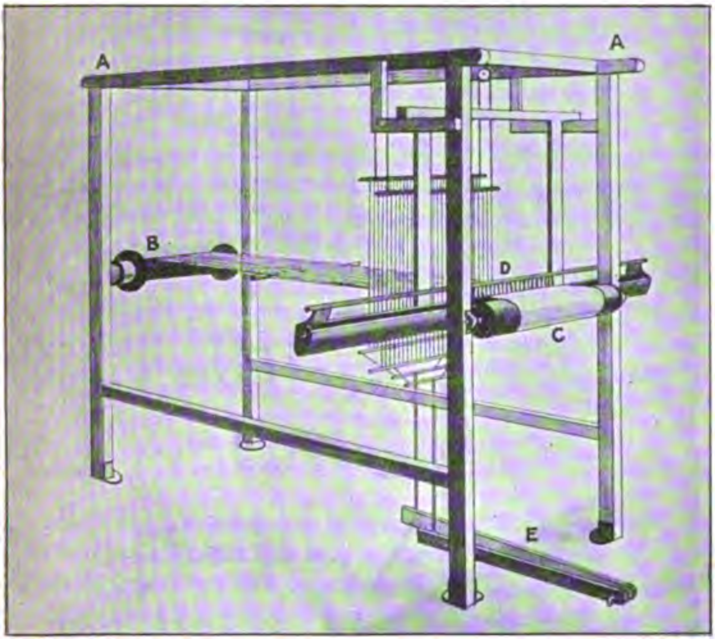


Figure 1. The Hand-Loom.

The rich mediæval cloths of which numerous examples exist were made on looms of the most primitive character. The manufacture of the exquisite Italian muslins, with their marvellous delicacy of texture, and of the elaborate and beautiful shawls of Cashmere, is carried on with the use of looms of the rudest and simplest construction.

In these ancient looms the shuttle, if a shuttle was used, as in some cases the work was performed by the use of a kind of needle, the weaver threw it by hand across the warp; and it is remarkable that the use of the fly shuttle did not come into operation before the year 1733, being invented by John Kay of Bury.

All weaving proper is done on the loom, which may be quite simple, or it may be done on looms of the most complex and ingenious mechanical construction. In the simplest form of weaving it is required to pass one set of threads transversely across another set, each one of the first set passing alternately over and under the threads of the other set, so as to interlock them and thus form an united surface.

In the weaving of cotton cloth of the present time a series of elaborate and intricate machines is made use of, and it will perhaps be as well to illustrate the manufacture on a hand-loom before proceeding to give any description of the various machines now in use.

The Hand Loom.

In Fig. 1 we have a hand or manual loom; (A) is the frame of the loom. At each end of the frame are fixed two rollers or beams (B) and (C), and from one to the other the threads of the warp are attached. The warp threads or yarn are wound round the warp beam (B), only so much thread being left unwound as will reach the cloth beam (C), to which the ends of yarn are fastened, and upon which the cloth is wound when woven. The next step is to divide the threads into two equal sets by raising up every alternate one and inserting between them a smooth rod of wood to prevent them entangling or returning to their former positions; the threads are then passed through the mail or eye of the heald, or heddle, there being always two sets of healds in the simplest form of loom. The heald consists of a frame in which there are a number of cords or threads arranged parallel and perpendicular, and in the centre of each cord is an eye or mail. The two healds

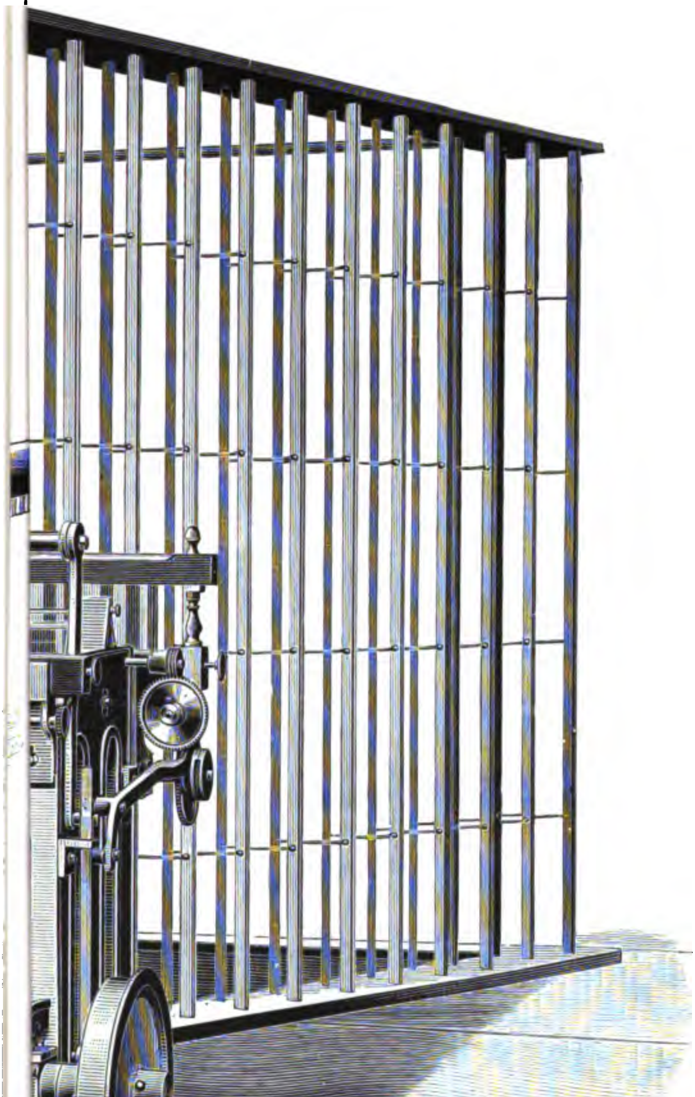
are placed one behind the other, and the threads from the yarn beam are passed alternately through the front one and the rear one. Immediately in front of the healds is the "slay" (D) containing the shuttle and reed, the slay being slung to the top of the loom frame. The reed is a frame containing a metal comb through which the threads are carried forward to the cloth beam (C). To each heald is an attachment to the pedals (E), and the two healds are attached to each other by two straps, each passing over a pulley fixed at the top of the loom.

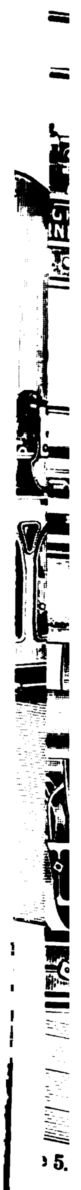
The operation of the weaver is as follows:—One of the pedals is depressed, which brings down the heald attached thereto, and consequently every alternate thread is depressed on the slay. A space or "shed" is thus formed between the threads, and the shuttle containing the weft or woof is jerked by a picker from the shuttle box at one end of the slay to the shuttle box at the other end. The foot is then lifted from the first pedal and the other pedal then depressed, causing the heald attached thereto to be brought down, bringing with it the threads that formed the upper portion of the shed in the first instance, and at the same time lifting the first-mentioned heald. The shuttle is again jerked through the shed to its original position in the first shuttle box. It will thus be seen that the weft is passed over and under each alternate thread and the web or cloth formed. The operation is thus continued, first one set of alternating threads and then the other being depressed. Whilst this is being carried on the weaver after each shot of the shuttle brings the slay, which is movable, forward towards himself, and presses the web close together. When enough cloth has been manufactured he winds the cloth on to the cloth beam (C) by a rack, and by the same operation draws more warp from the warp beam (B).

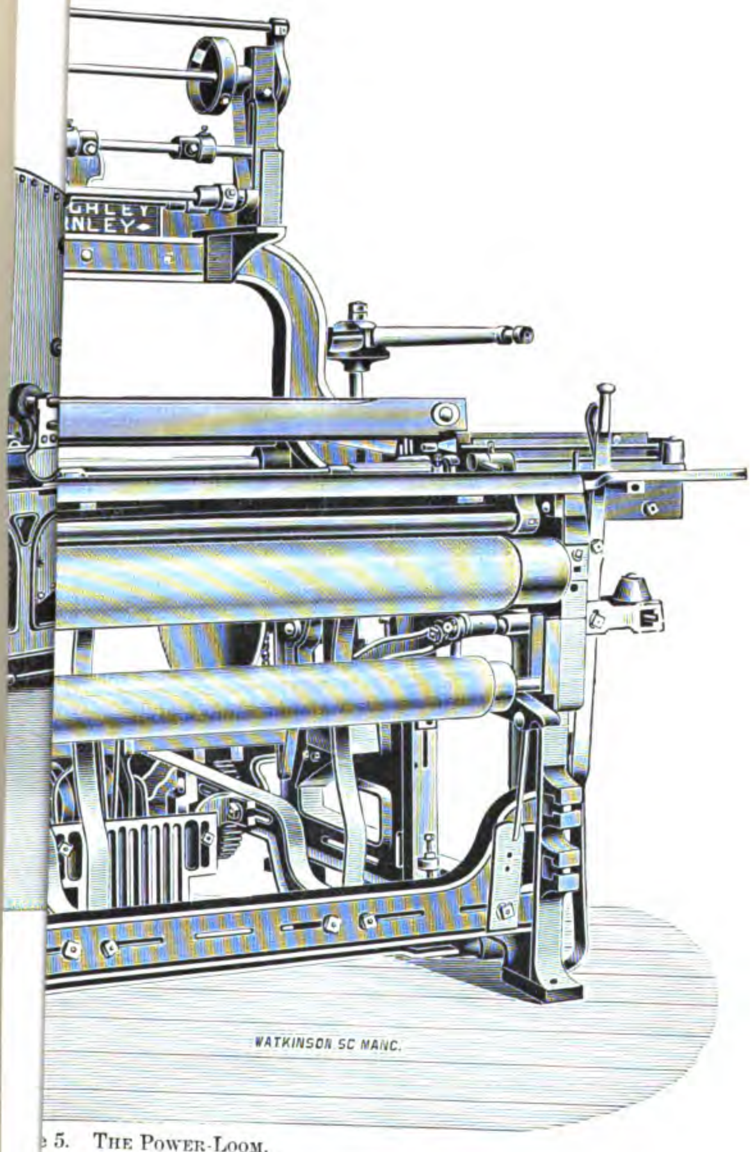
The picker before mentioned is generally made of leather, buffalo hide, or composition, and is fixed on a spindle or runner in the shuttle box, there being two in a loom such as has been described, one in each of the shuttle boxes at the end of the slay. To each picker is fastened a string known as the picker string, the two being fastened at the other ends to a stick known as the picker stick, which the operative holds in his right hand.

In the manufacture of a plain cloth or calico in a modern power loom various processes are required before the yarn from the spinner can be fixed in the loom.

Assuming the yarn comes from the spinner in the form of cops







5. THE POWER-LOOM.

(in some cases it reaches the manufacturer from the spinner or dyer in the form of hanks), the first process necessary is that of cop-winding.

Cop Winding.

The cops are placed on wood or metal skewers in front of and under the machine (Fig. 2), and the threads then pass over the flannel board and brush in front, through the guide, and on to the bobbins at the top of the machine ; as the bobbins rotate the guide works slowly up and down so as to fill them equally. The bobbins when full are then carried to the warping mill.

Warping Mill.

The bobbins are placed on the creel at the back of the machine (Fig. 3), and the threads are brought forward and passed through the standing reed at the top, over a set of rollers, and thence to the beam at the front, to which the ends are fastened. The beam rotates and winds on the threads from the bobbins in the required order.

As yarn is of a rather fragile nature and easily breakable, it is then sized to give it strength and weight, which operation is performed upon the slashing machine.

Slashing, Tapeing, Sizeing, or Dressing.

The full warp beams from the warping mill are placed in position at the rear of the machine (Fig. 4), and the yarn passes over rollers and through a trough containing size, then round the two large steam-heated drums in the centre of the machine, and thence to the warp beam at the front.

It is usual to work through the machines several sets of warp yarns at one time according to the number of ends required on the loom beam ; in the diagram are shown six warp beams being unwound at the same time. Between the larger drum in the centre of the machine and the loom beam in the front are several dividing rods which pass between the sets of warp to prevent them adhering together. The warp is now ready to be placed in the loom, and to attain this an operation by hand is necessary known as "drawing in."

The two healds and the loom reed are hung on an apparatus called the looming or drawing-in frame, and the operative with a heald hook, which is a kind of thick needle with a hook at the end, draws the threads from the beam through the eyes of the heald, and with a reed knife through the reed; the warp beam, healds, and reed are now ready to be placed in the loom.

The Power Loom.

This loom was invented in 1785 by a clergyman named Dr. Cartwright, who spent some £40,000 in perfecting his invention, which at first met with violent opposition on the part of the public, so much so that he did not reap the pecuniary reward his invention merited. Subsequently, however, in 1809 he was awarded £10,000 by Government.

A loom invented by Jacques de Vaucanson in 1745 foreshadowed some of the salient features of the power-loom, and, had he known of the fly shuttle, it is probable he might have forestalled in their inventions both Dr. Cartwright and Jacquard (whose loom will be mentioned later on).

The power-loom (Fig. 5) performs the work as in the hand-loom already described in Fig. 1, with the exception that the necessary motions are induced by power and not by manual labour.

There is, however, an ingenious arrangement in this loom, namely, the weft fork, for stopping the loom in case the weft should break. At one side of the loom near the shuttle box is a small spindle, balanced in the middle, having at one end a small fork, bent inwards, which presses against the taut weft. As the slay moves forward to push up the last pick in the cloth, this pressure causes the other end of the spindle to be lifted; but should the weft break, the pressure being released, the tilted end falls down and catches, by a sort of rack arrangement, a bar which throws the loom out of gear.

When it is necessary the yarn should be taken out of the cop form into hanks for dyeing, packing for export, or other purposes, a reeling machine is used.

The cops are placed on the spindles at the top of the machine (Fig. 6) and wound off on to the swift in front. In the figure shown here ring spindle-bobbins are being unwound, as the reeling machine can be used for either mule cops, ring or throstle bobbins.

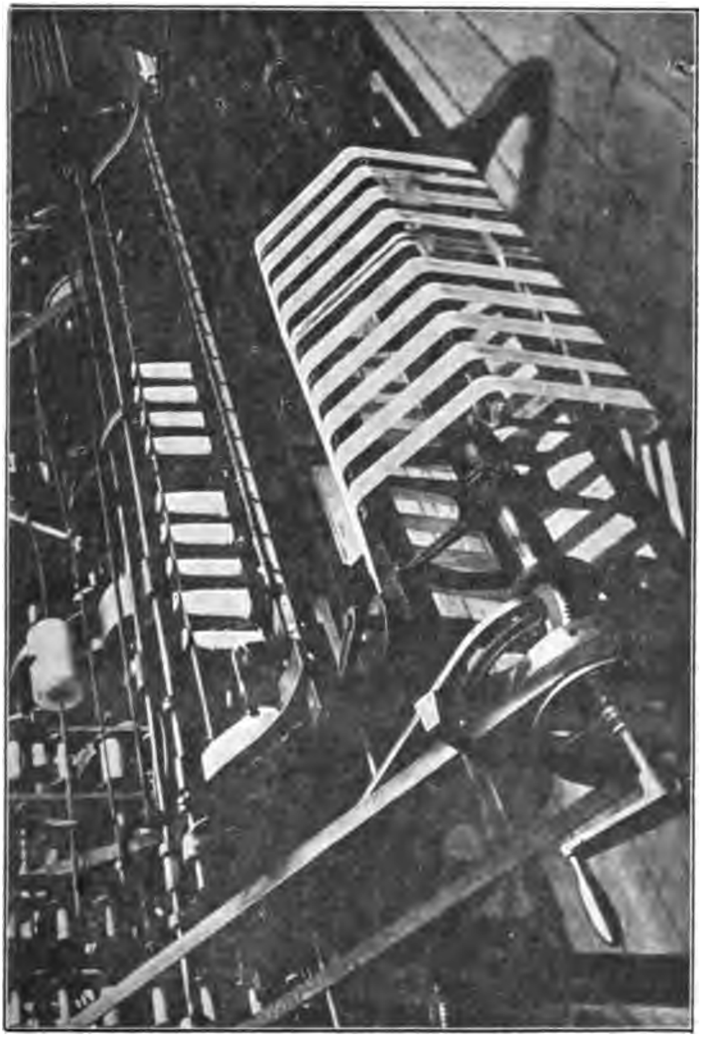
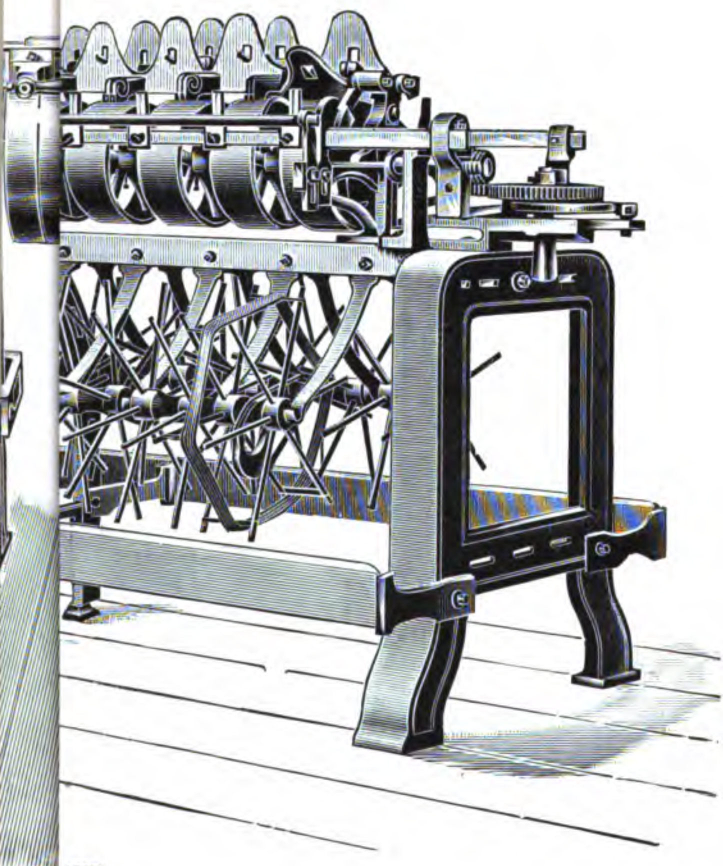


Figure 6. Reeling Machine.



.AME.

The hanks when reeled are taken off the machine, tied, folded, and are then ready to be sent to the dyer or manufacturer if the reeling has been done by the spinner, which is not unusual.

The hank having arrived at the shed or factory, should the yarn be required for weft, a pirn-winding machine is brought into requisition for the purpose of winding the yarn from the hank on to a small hollow wooden spindle or pirn, which when filled can be placed in the shuttle in the same manner as a cop.

Pirn Winding.

The hanks are placed on the cage shown in front of the machine (Fig. 7), the yarn passing upwards over a moveable guide to the spindle at the top of the machine on which the pirn is fixed, and on which the yarn is wound.

In dealing with the hanks for warp purposes, it is necessary to wind them on to bobbins by the use of a drum-winding frame.

Drum-Winding Frame.

The hanks are placed on the cage in front, and the yarn passes over a guide to the bobbins at the top of the machine (Fig. 8), which are placed horizontally, and on which the yarn is wound. The guide in this machine has a horizontal and not a vertical motion, as in the cop and pirn-winding machines already described.

Where warps are to be used in the loom of different coloured threads they are generally warped off in sets, in which case a sectional warping machine is used.

Sectional Warping Machine.

The bobbins are placed on the creel at the back of the machine (Fig. 9), as in the warping mill already described, and the yarn passes through a reed at the top, over a roller for measuring, and on to the small beam in front. At the side of the measuring roller is a clockwork arrangement by which is indicated the amount of warp that has passed over the roller. The section in the beam can be removed and fitted along with other sections to the width in the loom beam.

There is another kind of warping machine sometimes used where short lengths are required, known as "The Balloon Warping Mill." This machine is practically the same as the warping mill in

Fig. 3, with this exception—instead of the warp after passing the reed being wound on to the loom beam, it is wound round a large circular cage or creel, and when the full length has been wound off, the warp may be taken off by hand and placed on the floor—somewhat after the manner a sailor coils a rope—and then tied in a bundle, or, if desired, may be taken off in the form of a ball, the operative using two sticks crossed, around which the warp is wound in a crosswise manner. When balled, the sticks are withdrawn and the ball tied. There is also in use a small machine for balling by which the operation may be performed, which dispenses with the hand labour.

In case warping has been done on a balloon warping mill, it is necessary to transfer the yarn in the bundle or ball to the loom beam by means of a beam or running-off frame. The bundle or ball is untied, the ends passed over rails at one end of the frame, then carried through a moveable reed which is held up by the threads of the warp, and on to the loom beam round which it is wound. This process is sometimes referred to as warp dressing.

It will be at once seen that the ordinary loom (as in Fig. 5) would be quite unequal to the task of weaving a piece with divers coloured warps, where the various colours might run in sets of varied numbers. The use, therefore, of a loom with several healds, known as the dobbie loom, is brought into requisition.

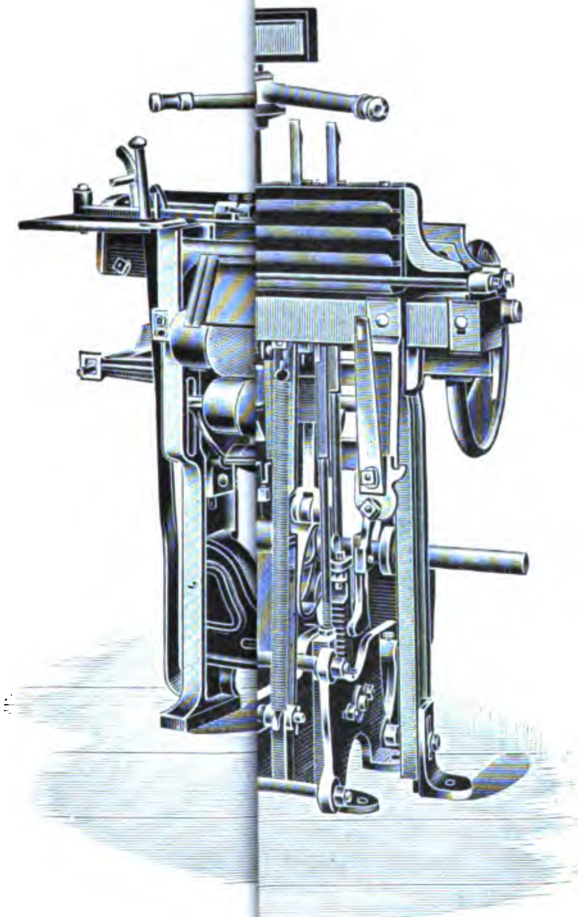
Dobbie Loom.

Over the loom (Fig. 10) is an apparatus by which a number of lifters, from each of which a heald is suspended, is so arranged that each particular set of threads in one or more healds can be brought up to and form the top of the shed through which the shuttle passes, and then dropped and replaced by other sets as required.

Then, again, in case the manufacturer wishes to produce a cloth in which the weft shall vary in colour, it will be seen that the use of more than one shuttle will be necessary; the shuttle containing one colour of weft being shot through the warp, the other shuttles being at the same time withheld. This is effected by the drop-box loom.

Drop-Box Loom.

At the side of the loom (Fig. 11) is a box containing several shuttles, and the mechanism of the machine is so arranged that the



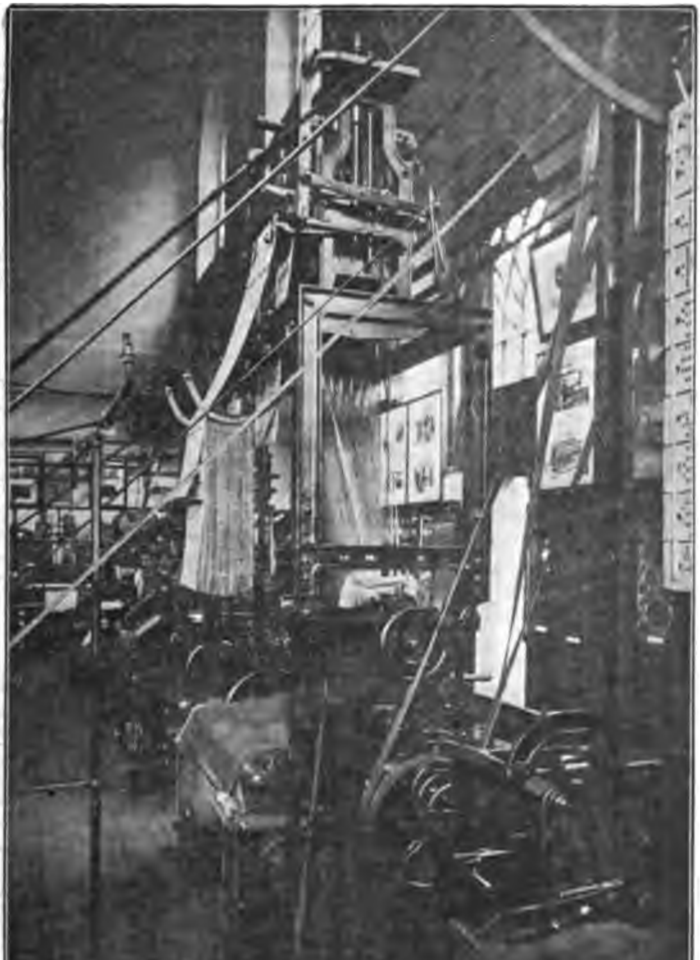
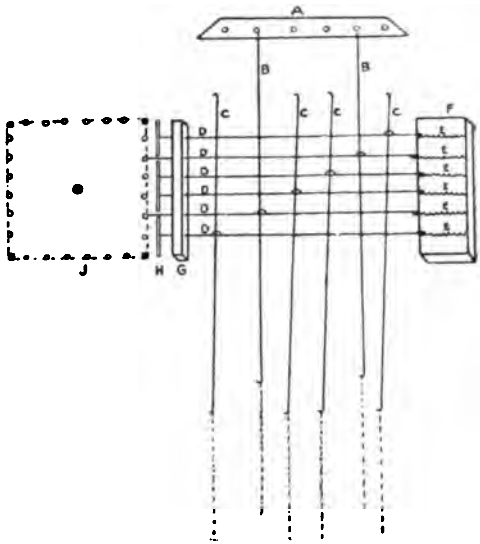


Figure 12. JACQUARD LOOM.



Figuro 13.

shelf in the box containing the shuttle in which the desired colour of weft is fixed is brought level with the slay, and the shuttle jerked by the picker through the warp. If the next pick is to be of another colour, another compartment or shelf in the box is brought to the level of the slay, and so on the operation is continued.

In the manufacture of goods with both varied warp and weft, the mechanism of the loom may combine both the dobbie and drop-box arrangements. The looms already described are those in use for the manufacture of plain calico and for the various kinds of checks.

For more elaborate fabrics, a loom known as the Jacquard frame is brought into use, a piece of mechanism as marvellous and ingenious in its construction as was ever devised by the wit of man.

This apparatus was invented by Joseph Marie Jacquard, of Lyons, in 1801, and it is noteworthy to remember that so coldly was his invention received, that, although Napoleon rewarded the inventor, the machine did not at once come into general use; in fact, so violent was the opposition offered by the Association appointed to protect the weavers of his native city, that his machine was publicly burned on the very spot where now stands a statue to his memory.

Jacquard Loom.

In making a figured or more elaborate cloth the shed of the warp of necessity consists of varying coloured threads brought to the top of the shed in different numbers and colours until the pattern is completed; it is therefore impossible to have the requisite number of healds in the loom (Fig. 12) to perform the work. In the Jacquard loom healds are dispensed with, and the lifting threads, instead of being arranged in healds, are separate, being hung from the top of the loom. The number of the lifting threads varies according to the pattern required, running in some looms to as many as from 300 to 900. These threads are worked as follows:—

Each of the lifting threads (Fig. 13), like those in the heald, has an eye through which the warp passes. At the top of the machine is a lifting bar or griffe (marked A), on which are several projections arranged so as to lift the hooked wires (bb and cccc.) At the

lower ends of these wires are attached the lifting threads of loom; each of these wires passes through a loop in one of transverse wires (D), which are fastened to springs in the spr box (F). These wires (D) pass through the frame (G). Oppo to the spring box is a squared perforated cylinder (J), over wh pass the perforated pattern cards (H), which are strung toget and hang at the side of the loom, as in Fig. 12. Each of th cards is perforated with as many holes as wires are required lift the necessary warp threads to the top of the shed. Most the lifting threads in a loom lift more than one eye at one ti several threads containing eyes being attached to one lift thread, if the design of the pattern in the loom permits. T cylinder (J) is made to press forward towards the frame (G), a the card pushes back on their springs such wires as are n opposite to the holes in the card, the remainder of the wires p through such holes and into the perforated cylinder. By th action the wires (cccc) are deflected and pushed off the projectio on the griffe (A); the remainder (bb) remaining perpendicul are lifted as the griffe works upwards. The cylinder (J) is mov backwards, and, making a quarter turn of its circumference, fresh card brought down, the wires (dd) being pressed back their original positions by the springs in the spring box (F The operation is then repeated, a different set of wires passin through the card, which is perforated in the desired manner.

The cloth, after being woven, is taken to the warehouse fo examination, to see there are no imperfections in it, such a broken threads and the like; this is usually referred to as cut looking, the operative employed for the purpose being named cut-looker.

The cloth is then plaited or folded by a plaiting or foldin machine. (Fig. 14.)

Plaiting or Folding Machine.

There are various other machines and looms in use for cotto manufacturing, but those already mentioned give a shor and general idea of the methods employed by which a piece o cotton cloth is produced.

FIRE HAZARD.

In considering the fire hazard of a Cotton Factory or Shed, the conditions presented by any particular risk are such as may easily mislead a novitiate in the practice of surveying, as the buildings are in most cases of no particular height compared with the buildings appertaining to other classes of manufacture, consisting in most cases of a shed, and a two or more storied building for warehouse and preparation purposes, with the necessary adjacent structures used as offices and engine and boiler houses.

The number of factories is very small compared with that of weaving sheds.

The power required is not of any magnitude, the weight of machinery to be turned being light compared with that of a cotton spinning mill, and the motions of the machinery are comparatively slow, therefore the risk from friction is consequently reduced to a low degree.

Nevertheless, the destructive character of the numerous fires that have occurred in Cotton Factories and Sheds in this district of late years has caused much searching of heart amongst managers of Fire Offices.

In considering the number of fires that have recently occurred, and which have resulted in very serious loss to the Fire Offices, we are confronted at the outset with the fact that in the majority of cases the direct causes of such fires have been beyond the power of either the assured, assessor, or surveyor to fathom, and have been generally scheduled by the offices as unknown; and, further, by the fact that in the great majority of cases such fires have arisen in two-storied buildings in which the preparatory processes, such as warping and sizing, are carried on; and it will be as well also to remember that where such processes are carried on, the liability from friction is reduced to a minimum consequent on the slow motion of the machines and the lightness of the power requisite to turn them.

Fires occasionally take place in weaving sheds, but these are in nearly every instance quenched before any but little damage has been done, other than the destruction in the loom of the piece in process of manufacture, and a slight damage being occasioned to the mechanism of the loom by water; but where fires have occurred in the two storied buildings used as warehouses and for preparatory purposes, and which usually communicate with the

shed, the loss to the Insuring Offices has been generally of a most disastrous character.

In a number of fires that occurred during the five years 1895 to 1899, amounting in all to 27, in which the gross loss amounted to over £113,000, an analysis shows the following results:—

8, or 29·6 %, occurred between the hours of 6 P.M. and 6 A.M.
14, or 51·8 %, " " 6 A.M. and 6 P.M.
5, or 18·5 %, are reported as having been discovered either at the opening or closing of the Factory, 6 A.M. or 6 P.M.

17 occurred in buildings used as Warehouses or preparation rooms.
4 in the Weaving Sheds or Factories.
1 in the Engine-house.
1 in the Boiler-house.
1 in an Oil Store.
2 not known, as the premises were totally destroyed.
1 reported as damaged by fire arising in an adjoining risk.

It will be observed that the greater number of the fires occurred in the warehouse and preparation rooms, which are generally situated in a building of two or more storys in height adjoining and communicating with the shed, and the question arises, What were the causes of these fires?

The analysis shows the following:—

5 were caused by gas lights.
5 " friction.
1 was caused by an explosion of escaping gas.
1 " a lamp overturning.
1 was damaged by fire arising in an adjoining risk.
14 were from unknown causes.

It will be seen that more than one-half of the fires occurred during working hours, over 62 % occurred in the buildings used as warehouses and preparation rooms, and more than 51 % occurred from unknown causes.

These figures illustrate in an unmistakeable manner that most of the fires arose in the buildiugs used as warehouses and preparation rooms, and in considering the Fire hazard of any particular shed or factory the Surveyor's attention should be particularly addressed to these buildings.

The general points, it will probably be necessary to observe, other than those appertaining to any particular risk, appear to be as follows:—

1. That the gas brackets are fixed in such positions that they shall not under any circumstances come into contact with any part of the machinery, the manufactured cloth, the yarn in process of preparation, any wood partitioning, or doors or stores. It would be perhaps as well to pay particular attention to the last named, these being in many cases hung to the ceilings or placed on shelves attached to the ceilings or roof.

2. That the lighting-up be done with the use of enclosed lanterns, and not by the use of matches, tapers, and the like.

3. That the floors are in a cleanly condition, and particularly that there is no oily waste, after being used for cleaning machinery, left about the room in a loose manner, as it is more than probable that a number, indeed perhaps the greater number, of the fires reported as from causes unknown arose from the spontaneous ignition of such waste.

With regard to the sheds and rooms of factories in which weaving is carried on, the above observations will also apply; but particular attention should be paid to the lights, especially where Jacquard looms are used, to see that none of the brackets are in such a position as to endanger the harness of the looms.

It is usual in a shed or factory for the operative to place all loose waste in a pocket in her brat or apron, and such waste should be collected in some small metal receptacle and carried along with all sweepings to an isolated building clear of all other structures, the premises being quite clear of waste before they are closed for the night.

In conclusion, I beg to thank the various gentlemen for the time and trouble they have expended in taking out the particulars from which the above Fire Loss experience has been gathered, and especially my thanks are more particularly due to the firm of Messrs. Keighley & Co., of Burnley, for their kindness in allowing me the use of their printing blocks from which to illustrate this paper.

J. H. BAGSHAW.

Manchester Insurance Institute,
6th February, 1900.

METAL-WORKING RISKS.

(a) Bedstead Works.

In commencing a series of Addresses on Metal-working Risks in the Midland District we naturally place Bedstead Works first, as it is not our intention in this series to deal with the heavy trades, such as Metal-rolling, Engineering, or Locomotive Building, but rather with the lighter class, such as Tin-plate Workers, Brass Founders, Electro-platers, Needle Works and Fishing-tackle Works, Cycle Works, Machine Makers, Tool Works, and the like.

Bedstead Works, therefore, easily come first.

They are able to point to ancient custom in their favour, for we read in the Scriptures that Og, King of Basan, had an iron bedstead, and one, too, of no mean size, as, from the dimensions given, it is calculated it was built for a man 12 feet high. This was 1450 b.c.

Bedsteads were common in Egypt and among the Greeks, for many ornate bedsteads are depicted on the tombs along the River Nile.

Birmingham has for many years been the most important centre for this particular industry. In 1849 there were eight manufacturers of metallic bedsteads. In 1865 there were twenty, and the weekly output was about 20,000. In 1898 there were in Birmingham and the Black Country about forty maufacturers with a more than proportionately increased output.

Of course, the district is most favourably situated in having the coal and iron on the spot. Indeed, this must have been the reason for the metal trades locating themselves here—just as the potters settled in the North of Staffordshire, because they found there a peculiar kind of clay specially suited for the manufacture of china and earthenware.

Iron is the substance most largely used in the manufacture of bedsteads.

It is produced from iron ore dug out of the ground. At any time the curious may see, at Hanley, in North Staffordshire, the

iron ore on Earl Granville's estate undergoing its preparatory process. It is mixed in a huge bank with about its own weight of slack coal and then ignited. After burning for some time, all the adherent soil, &c., is burned away, and the ore, in practically a pure form, is conveyed in trucks to the huge smelting furnaces.

A smelting furnace of the largest size will contain about 150 tons of ignited material (iron ore, coal and coke, and limestone flux). It usually burns out about 550 tons per week.

Pig iron is produced from these furnaces, and it is a very pretty sight to watch the operation. A main channel, called the Sow, is scooped in the ground, into which the metal flows from the tapping hole of the furnace. On each side of the sow are shallow ditches to receive the metal from the main stem, and these laterals are called Pigs from a fanciful resemblance to the sow and pigs.

Pig iron is brought into the bedstead works and transferred to the cupola—a vertical iron furnace for fusing the metal.

It is then conveyed in ladles to the foundry, in which the main parts of the bedstead are made. Here the mould-makers have prepared the casting, which is made from a wood pattern made $\frac{1}{8}$-th of an inch to the foot longer in the case of cast iron and $\frac{3}{16}$-th longer in the case of brass to allow for shrinking. The pattern is laid in sand, often contained in a casting frame, which, from its non-fusibility, lends itself best to mould-making. The mould is dusted over with charcoal or with a mixture known as founders' dust, and the casting is then made by pouring in metal. With small articles in brass, metal patterns are used.

The foundry is invariably a lofty building of one story, and usually detached from the rest of the works, as is also the case in the brass-casting shops when the works make brass bedsteads.

Brass is composed of spelter (which is really refined zinc) and copper. To make the material harder a larger proportion of spelter is used, to make it softer a larger proportion of copper.

Brass furnaces wherein the two metals are fused are sunk in the ground and fired under. Crucibles containing the metal are deposited in the fireholes. When the contents are molten the crucibles are lifted out by means of tongs, by hand where the crucibles are small, and by means of a travelling crane where too large for hand-power.

From the foundry the component parts are taken to the blacking or japanning room, where, after being coated with varnish, they are placed in stoves and dried.

This varnish for black goods is composed of shellac, methylated spirits, and asphaltum dissolved in benzine, with lamp black added. It is, of course, highly inflammable, and with the stoving constitutes one of the principal risks from an insurance point of view. The stoves are built of brick cased with iron and entered by iron doors. The fire heat is supplied from flues fired outside. So far as I can ascertain, they are heated up to about 200 deg. Fahrenheit, but there is very much "rule of thumb" about the operation, as nearly every one in charge of stoves appears to have a method of his own.

It is interesting to note this process derives its name from the fact that it first originated in Japan.

After being stoved the pillars are taken to the ornamenting room, where "transfers" are placed upon them for decoration.

The portion to be ornamented is thinly coated with copal varnish. The "transfer," which is of thin paper, is then applied firmly, after which it is moistened with warm water on the back and easily removed, leaving the design fixed upon the pillar.

The next step is to the warehouse, where all the component parts are assembled, and from here to the packing-room (where necessarily a large quantity of straw is stored) ready for despatch.

It is obvious, however, that we have only dealt with the large parts of a bedstead, such as the head and foot and the sides, together with the laths. There are various sundries, such as castors, which are of china and come from the Potteries, and therefore do not further occupy our attention, and there are also sundry brass ornaments upon the bedstead which are either entirely manufactured upon the premises or are purchased in a rough state.

These involve press tool work or stamping and polishing. The latter is a most important process, from an insurance point of view, as Sheffield lime is used, and this, we know by experience, is a prolific cause of fire—the lime having the property of spontaneous combustion when damp—hence we require the polishing benches to have metal trays, the floor to be swept each day and the refuse removed. The Sheffield lime, which is really limestone, must be kept dry and stored only in a metal box.

After polishing, these brass ornaments require to be lacquered to prevent them rusting and to preserve their brilliant appearance. Lacquer is composed of shellac dissolved in methylated spirit and coloured by means of dragon's blood, turmeric, and other colouring matters to the required shade.

It is applied by small brushes, and the articles are afterwards placed upon lacquering stoves to dry. These stoves are slabs of metal, sometimes fired under, at others heated by steam or by gas up to about 230 deg. Fahrenheit.

In works where brass bedsteads are made as well as iron, there will be found workshops for making cased tube. A whole brass bedstead is, of course, a very expensive production, especially at the present price of copper, but very handsome bedsteads are made very similar in appearance, but of cased tube. This is a hollow tube cased with brass.

From an insurance standpoint, we cannot consider bedstead works a good class of risk. They usually run three to four stories high, and in one building we can find the japanning stoves, polishing shops, lacquering shops, workshops, and packing-room. There are generally numerous pipe stoves in the workshops, and from the nature of the trade the whole premises are crowded, and, owing to the value of the goods, there is a considerable sum at stake.

From returns furnished me by local managers and by Superintendent Tozer, of the Birmingham Fire Brigade, I find that during the last seven years there have been in Birmingham alone no less than thirty-three fires in works of this class, involving an estimated damage of £19,521.

This is a very high percentage, as the number of bedstead works in the city is comparatively small.

Superintendent Tozer is particularly careful to ascertain, if possible, the exact cause of the outbreak, and he classifies the 33 cases as follows:—

Furnaces (japanning and other stoves),	caused	8
Gas, &c. (swinging gas-brackets usually),	,,	5
Spontaneous combustion,	,,	3
Hot ashes,	,,	4
Burning rubbish,	,,	3
Boiling oil,	,,	1
Timber too near stoves,	,,	4
Unknown,	,,	5
		33

Such, however, is the competition in this district as regards fire insurance that we find the current rates are only 3s. to 4s. 6d. per cent., obviously quite inadequate, and it is almost difficult to

understand why such rates are accepted. Such offices as have studied the loss experience do their best to keep off the risks, or, if obliged to accept them for the sake of agency connection, retain very small sums. There are many who have not gone into the matter thoroughly, and they continue to freely accept the works at these low rates.

Some of the bedstead works have recently added the manufacture of wire mattresses and small wooden bedsteads with wire mattresses attached. This involves wood-working machinery, and should obviously carry a greatly increased rate over the purely metal-working risks.

In 1896 I drafted some suggestions for a schedule of charges for metal-working risks. I do not think it is at all an impossible task to frame a scale for these risks, and these are my suggestions:—

For premises in the occupation of Metal Rollers, Engineers, Iron and Tin-plate Workers, Bedstead Manufacturers, Electro-platers, Brass and Iron Founders, Cycle Manufacturers, and all Workers in Metal—

Normal Rate, . . 3s. per cent.
Brick or stone or iron built; slated or tiled or iron roof.

Additional Rates.

1. If more than one story, for each additional story,	6d.
2. Defective construction, ...	1s. 0d.
3. Lighted other than by gas or electricity, . .	1s. 0d.
4. If using pipe stoves or core stores, muffles, enamelling or annealing furnaces, japanning stoves, brazing hearths, lacquering stoves or furnaces, ...	1s. 6d.
5. If any Sheffield lime used, ...	1s. 0d.
6. Straw-packing room inside the building, . .	1s. 0d.

In the case of bedstead works generally, the rating would probably average—

Normal, ...	3s. 0d.
Height (three stories), ...	1s. 0d.
Stoves, &c., ...	1s. 6d.
Sheffield lime, ...	1s. 0d.
Packing, ...	1s. 0d.
	7s. 6d.

I strongly feel, and this has been the great inducement to me to prepare these few notes, that bedstead works form an inferior class of risk. The experience has been generally unfavourable, and the rates at present obtained are quite inadequate.

The works need careful survey—and I would say *frequent* survey—especially at the commencement of winter, when the pipe stoves, dismantled and stored away in the summer, are once more brought into use. The japan stoves need particularly careful examination, especially as regards the flues. The polishing-shops should be kept as clean as possible; and, of course, I need hardly say, the lights in packing-room should be enclosed in glass lanterns—and the glass should *not* be broken, as, unfortunately, we find is often the case. In the warehouse, too, where the bedsteads are wrapped in hay or straw or in brown paper, the gas-lights require to be fixed, if possible, on the walls, and not suspended from the ceiling.

If these few words of mine result in attention being particularly directed to this class of risk, and the rates improved, my object will have been fully accomplished.

J. HEADON BOOCOCK.

Birmingham Insurance Institute,
24th November, 1899.

Note: 7th July, 1900.—From 24th November, 1899, to this date there have been eight fires in bedstead works in Birmingham; three occasioned by stoves, two from gas, one from hot ashes, one from vapour in contact, and one from timber too near. The insurance at risk was very considerable, and the actual damage amounted to £2577.

J. H. B.

ROPE WORKS.

I TAKE it that no one will dispute the assertion that rope-making is one of the primitive and universal arts. In all ages and all countries ropes have been made from a variety of material, such as grasses and fibres of various kinds, hair and intestines of animals, and strips of hide. It would be an interesting study to trace the development of the art from the time when every man was, so to speak, his own rope-maker down to the present time, when rope-making presents itself as a highly specialised business. That, however, is beyond the scope of this paper. I propose to direct my remarks mainly to a description of the works in which rope-making is carried on to-day, considering the processes and materials used from a fire insurance standpoint.

Rope-making is an old industry on Tyneside. The Incorporated Company of Rope Makers of this city dates from 1648. Probably the connection of the district with shipping and mining and the trade with the Baltic ports, whence most of the raw materials for rope-making originally came, account for the early and permanent establishment of the industry here. At the present time there are on the Tyne, Wear, and Tees some thirteen rope works—seven of these are wire-rope works only, and the other six are both hemp and wire works. At the 1889 meeting of the British Association, Mr. R. Dixon, in a paper on the Rope-making Industry of the district, stated that the annual local turnover of manilla was 3000 tons, of hemp 2000 tons ; while the output of wire rope was 9000 tons. The operatives employed were estimated at 800 hands in the hemp and manilla, and 400 in the wire manufacture. I have been unable to find any later statistics, but, while the number of works has not increased, it is highly probable that the output has increased materially during the last eleven years. Wherever there is a demand for large quantities of rope for shipping or colliery purposes rope works have been established, so that the industry is a widely distributed one. In Lancashire and Yorkshire there are fifteen hemp and eight wire

roperies; in the Midlands eight wire roperies and several hemp works. London, Leith, Greenock, Glasgow, and Belfast also have large roperies, one of the Belfast works (that of the Belfast Rope Work Co.) being a magnificent risk, and the largest manufactory of the kind in the world. We cannot, therefore, in this district claim any monopoly of rope-making; all we can say is that the district has its fair quota of hemp and wire rope works.

Rope is technically defined as cordage of more than one inch circumference. Our local works are mostly engaged in turning out cordage that answers this description, although finer cords, twine, and line are made to some extent—a large amount of manilla twine for self-binder reaping machines, for example. Before considering what may be termed heavy cordage works, I might say a word in passing regarding twine, line, and small cord works. Most of you will be familiar with the small workshops for hand making of twine and line to be found in considerable numbers in country places and in fishing ports. They are usually buildings of poor construction, and it is not uncommon to find the preparing of fibre and tarring of yarn done all in the one building with the spinning. As a class they are not desirable risks, but they are of no great insurance moment, either individually or collectively. In machine making of twines and lines carried on as in the great works of the Belfast Rope Company (two out of three sections of which are devoted to this manufacture) the processes for the smaller counts of yarns are practically those used in flax spinning. A number of machines for scouring, sizing, and polishing twine are used, but none of the processes are hazardous. In Lancashire a large number of cotton band or rope works are found. The process is simply that of doubling waste cotton yarn, and there is no special feature of risk.

Coming, then, to consider the process of manufacture of heavy cordage, the subject naturally divides itself into two sections—first, hemp and other vegetable fibre rope-making, and, second, metallic wire rope-making. The first is in point of hazard much the more important, and to it I shall give most attention.

Hemp Rope-making.

The formation of ordinary hemp rope will be familiar to you all. Taken to pieces it is found to be composed of several strands, usually three, each strand being composed of a number of yarns,

and each yarn of a number of fibres twisted together. The object of twisting fibres together in a rope is that by mutual friction they may be held together when a strain is applied to the whole, and there is the secondary purpose of preventing the penetration of moisture. It is a mistake, however, to suppose that twisting gives additional strength to a rope—quite the opposite is the case. If it were possible to securely join the ends of lengths of fibre, keeping all the fibre straight and parallel, that would be the strongest form of rope, but no such method of joining the fibres is practicable; consequently we have to fall back upon the plan of making the ends of the fibres overlap and then twisting them together, so that they may adhere by mutual friction, although the torsion leads to a weakening of some of the fibres. The degree of twist usually given is such that rope is from three-fourths to two-thirds the length of the yarn composing it. The principal materials used in fibre rope-making are hemp, manilla, sisal, jute, and coir.

Hemp is a fibre obtained from the skin of the stalks of various plants of the genus *Cannabis*. It is grown in many countries —Russia, Italy, New Zealand, and to a small extent in Ireland and some of the Midland counties, but practically all hemp is now imported. Italian hemp is considered the best. Until the Crimean War in 1854 hemp was the fibre mainly used for rope-making, but in that year, owing to the supply from Russia ceasing, more attention was given to *Manilla* hemp. This is a fibre obtained from the leaves of a species of banana tree grown in the Philippine Islands. The fibre is very long, light, and strong, and since machinery (of American invention) was introduced capable of treating it successfully, it has largely superseded Russian and Italian hemp. At the present time, owing to the war in the Philippines, the supply of manilla is short, and the price much above the average.

Sisal is a fibre obtained from a species of agave or aloe, grown chiefly in Mexico. It is largely used for self-binder reaping-machine twine.

Jute is only used to a small extent in rope-making, and may be looked upon as practically an adulterant. It is deficient both in strength and durability.

Coir.—The fibre obtained from the husk of the cocoa-nut is extensively used for marine purposes (*e.g.*, the cable of 25 inches circumference recently turned out from the Willington Rope

Works of Messrs. R. Hood, Haggie, & Company). It makes a very buoyant and elastic rope. It is imported from the East Indies invariably in yarn form.

With regard to the relative merits of these fibres from the manufacturer's point of view, the first place must be given to manilla on account of its great length of staple, strength, and lightness. The average length of staple is as follows:—Manilla, 9 to 10 feet; Italian hemp, 6 to 7 feet; Russian, 3 to 4 feet; New Zealand, 7 to 9 feet; Sisal, 2½ to 3 feet. These fibres are placed approximately in the order of their relative strength, manilla being strongest. Manilla is imported in bales bound by cane bands; hemp in bales bound by roughly-twisted bands of hemp, and coir yarn comes in pressed bales bound by iron bands. The hemps contain a large amount of dusty particles, and their preliminary treatment before spinning gives rise to a great amount of dust and dirt. With manilla there is much less dirt and dust, partly because the material is much cleaner in itself, and partly because (on account of its harsh woody nature) it is treated at the outset with a mixture of oil and water. All these fibres differ from cotton and wool, not only in length of staple, but in being straight, and having no tendency to curl or felt. Flax, which is used to some extent for making fine lines and small rope of high strength, is a fibre of similar character to hemp.

Hand preparing and spinning.—The old system of preparing and spinning hemp for ropes by hand still prevails to some extent. The first process in it is that of heckling, *i.e.*, drawing (by hand) the lengths of hemp through a set of strong tapered steel teeth fixed in the end of a board, for the purpose of combing out the fibres, separating the long fibre (or line) from the tow or short fibre, and also of splitting up and making the fibres finer. Several sets of heckles may be used successively, each one having finer teeth than the one preceding it. A little oil is sometimes sprinkled on the heckles. The process is a very dirty and untidy one. Hand spinning is done in rope walks, long buildings, usually (like the twine shops already referred to) of inferior construction. At one end is a wheel which, on being turned, causes a number of hooks to revolve. To one of these hooks the spinner attaches a hank of hemp, and as the hook revolves and twists it into yarn, he feeds in more hemp from a quantity coiled round his waist, at the same time walking backward so as to keep the yarn taut.

Machine preparing and spinning is the method now chiefly

employed, the essential machines being *spreading* and *drawing frames* for preparing "line," *carding engines* and *drawing frames* for preparing "tow," and *spinning machines* for converting both kinds of fibre into yarn. In addition to these machines we occasionally meet with *heckling*, *teasing*, and *hemp-softening machines*, and with *dusting* or *willeying* machines. The fibre bales after being opened are sorted by hand. *Hand heckling* of hemp may be done to a slight extent even where preparing machinery is employed. *Machine heckling* is seldom done, but in a few places one finds a machine of the flax-heckling machine type used. *Teasing* is a process for opening out the tousled ends of lengths of hemp. The machine is usually a drum, having strong metal teeth in rows alternating with rows of steel knives (parallel with the circumference of the drum) encased in a wood or metal cover. The drum is driven round at a high speed, and the fibre being fed in, the knives and teeth effectively clear away all knots and lumps in it. The machine is objectionable on account of the risk of a spark from some foreign body setting fire to the fibre, particularly when the outer casing of the drum is of wood. *Hemp softening* is a process of "mangling" the hemp. The machine employed is a large metal drum having a fluted surface, on which are several smaller but heavy fluted rollers, the hemp being passed backwards and forwards between the drum and the rollers. In this way it is softened, so that a coarse, hard hemp may be used for purposes for which, without softening, it would be unsuitable. I have already mentioned that manilla is treated with oil and water as a preliminary process. It is the only fibre usually so treated. The mixture applied is one half oil and one half water. The oil used, known as "batching oil," is a heavy mineral oil. There are two methods of employing it. The commonest is by sprinkling the fibre from a large ordinary watering-can as it lies spread on the floor of the bale opening and sorting place. The other is by having a trough containing a supply of the oil fixed at the feed end of the first spreading machines, with a roller revolving in such a way as to throw out a continuous small quantity of oil on to an inclined metal sheet, from which it drips upon the material as it passes through the feed roller. The first system is objectionable, as it leads to the floor of the batching place becoming very greasy and dirty, besides encouraging the practice of leaving a quantity of oiled fibre on the floor over night, sufficient at least to keep the preparing machines going while a new supply is being oiled in the morning.

The *spreading* or *preparing machines* commonly used are what are known as double-sheeted chain gill spreaders (*see* Figure 1). The fibre, passing through fluted metal rollers under a slowly revolving metal bar wheel, is pressed down until it comes in contact with the first set of steel travelling teeth. These teeth are mounted on a series of bars which travel along by means of an endless chain. The first set of teeth move slowly, and simply spread or open out the fibre. When the fibre has been drawn to the end of the first set of teeth it is seized by a second bar wheel revolving slowly, which carries it into contact with the second and finer set of teeth, travelling much more quickly than the first set. From the second set of teeth the fibre passes out in a more or less straightened, continuous, and combed condition through a final pair of rollers. The machine performs two functions—first, the opening out and parallelising of the fibre, and second, the separation of the tow, or short fibre and refuse, which falls out below. Before passing to the *drawing frames* the fibre is put through several of these spreading or preparing machines, the number varying according to circumstances, each successive machine having finer and closer teeth than the preceding one. The tow or refuse is removed and separately treated afterwards. The next process is that of *drawing*. The machine (*see* Figure 2) consists essentially of several sets of rollers, revolving at different speeds, the feed rollers slowly and the succeeding rollers so much quicker that they further draw out the fibre. The principle is precisely the same as that of a cotton-drawing machine, with the difference that in passing from the feed rollers the band of fibre is carried over a set of fine slow-travelling metal teeth (similar in principle to those in the spreader) which serve to still further comb out and fine the fibre. After passing through a succession of drawing machines the fibre is delivered in the form of a thin continuous band, called a sliver. A slight twist is given to this by the delivery rollers, and it coils automatically into a metal can, when it is ready for spinning.

Spinning.—The type of machine used for spinning rope yarns is that known as Good's Automatic Spinner (*see* Figure 3). In it the sliver is passed, first through a pair of metal rollers (which govern the feed), then through a trumpet-shaped metal guide over a series of travelling metal teeth (which, as they move slower than the fibre is drawn by the spindle, serve to give it a final combing and parallelising), through a second metal guide on to the

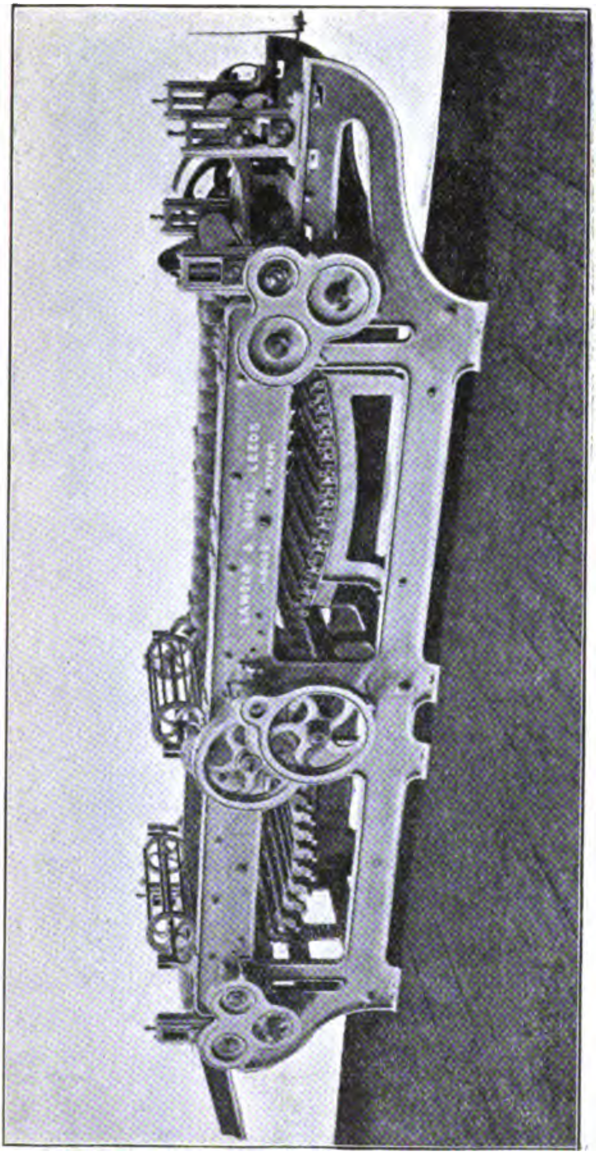


Fig. 1.

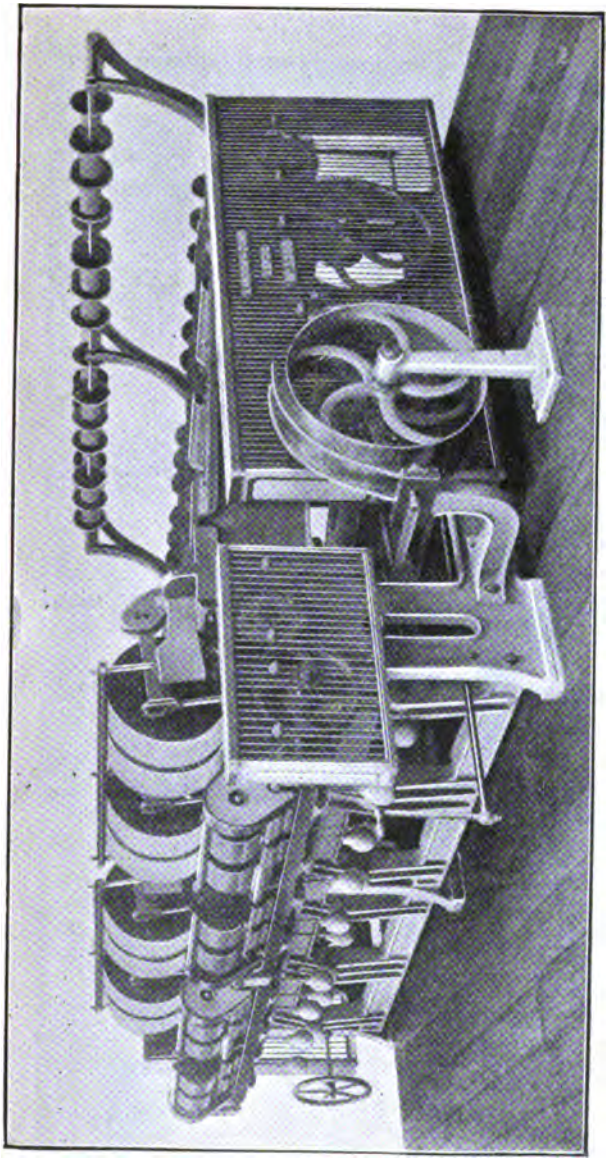


Fig. 2.

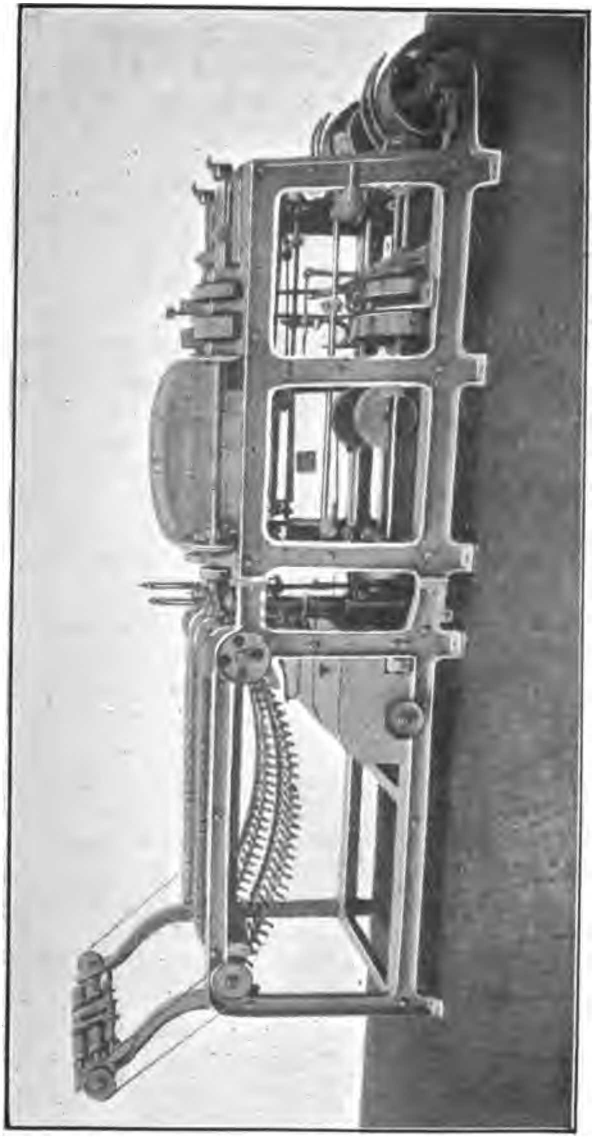


Fig. 3.

horizontal spindle. This spindle revolves at from 1200 to 1400 revolutions per minute. The number of spindles in each machine varies, for ordinary yarns two in each frame being the usual number, but for finer yarns machines with as many as six spindles are used. The machine, although simple in appearance, is really a wonderful piece of mechanism. It is so adjusted that the speed of the spindle varies as the delivery of the sliver is above or below the normal, while if a break in the sliver occurs the machine stops.

It will have been noticed that in all the machines I have described (preparing, drawing, and spinning) there is the common feature of the travelling teeth for straightening and combing out the fibre. A few words with regard to the treatment of the "tow" or short fibre and waste, obtained as a result of hand heckling or machine preparing, drawing, and spinning. In some works a preliminary machine for beating the dust or refuse is used. It is a simple form of shake willey, a drum set with metal teeth revolving at no great speed, with the object of separating the loose dust from the tow before the latter is passed to the carding engine. In other places the whole work of dealing with the tow and waste is done by the *carding engine.* This machine is in principle the same as the woollen and cotton carding engine, but of heavier type, the teeth on the drums being heavy metal ones instead of fine wire. The "Fearnought" Tenterhook Willey used in the woollen trade is in many respects a very similar machine. The sliver delivered from the card is treated in drawing frames and spun as before described. The dust and refuse from the card, and from the duster where such is used, are disposed of to makers of boiler covering composition. The process of dusting and carding is obviously hazardous.

Tarring.—When yarn is required for rope that will be subject to the action of water, it is tarred. Tarring weakens the rope somewhat, but tar is the only known material that will preserve fibre in water. The tar used is Archangel, Stockholm, or American. The method of application is by passing the yarn through a trough containing a supply of tar heated to about 212 deg. Fahr., then drawing it off through rollers which squeeze out the superfluous tar. Yarn takes up about a fourth its weight of tar. The process is a dirty one, and especially hazardous where—as is still occasionally found—the heating of the tar is by fire heat and not by steam.

Tarred yarn is kept some time in hand, for navy purposes from

one to two years, but there is no indication that its storage is hazardous.

I have referred somewhat minutely to these preliminary processes because they represent the hazardous part of rope-making; the remaining processes are comparatively non-hazardous. In spinning, the yarn has received its first twisting. In "forming" the strands and "laying" the strands into rope we have two more twisting processes, but it should be noted that the twisting in each operation is in the opposite direction to that in the one preceding it. Two systems of rope-making are met with. First the rope-walk system, and second the house-machine system. The first system was at one time the only one; it is still used because some very heavy ropes are too cumbrous for even the largest machines, and again because certain special kinds of rope require dressing with a preparation of the nature of size, which can only dry satisfactorily when the ropes are stretched in a walk—if coiled on a drum mildew and rot would arise. *Forming* the strands in a rope walk is done as follows:—The ends of the required number of yarns are taken from bobbins placed in frame and passed through a number of concentric holes in a steel plate called a "register plate," then brought together and pressed through funnel-shaped tubes and attached to the hooks of the "forming machine" or "traveller." This machine travels down the rope walk on rails moved by an endless rope, and as it moves the hooks are rotated by gearing, thus forming the strand. When the full length of the walk is travelled by the machine the strands are unhooked, and each set of three is then laid together into a rope. The process consists of hanging three strands together on the centre hook of the machine at the bottom end, cutting away the strands at the top end and attaching them to three separate hooks, then setting the centre hook at the lower end in motion the reverse way.

Machine or Factory Rope-making is the modern system. It has the very important recommendation of being economical of space, it is said to turn out more regular and uniform rope than the walk system, and by it the length of rope made is limited only by the carrying capacity of the taking-off drum. The machines employed are, 1st, strand-forming machines; 2nd, rope-laying machines, and 3rd, machines that combine both operations. In all the machines the principle is that of winding off the strands or rope as made on large bobbins or drums. In the *stranding machines* the yarns are taken from a bobbin frame through a register

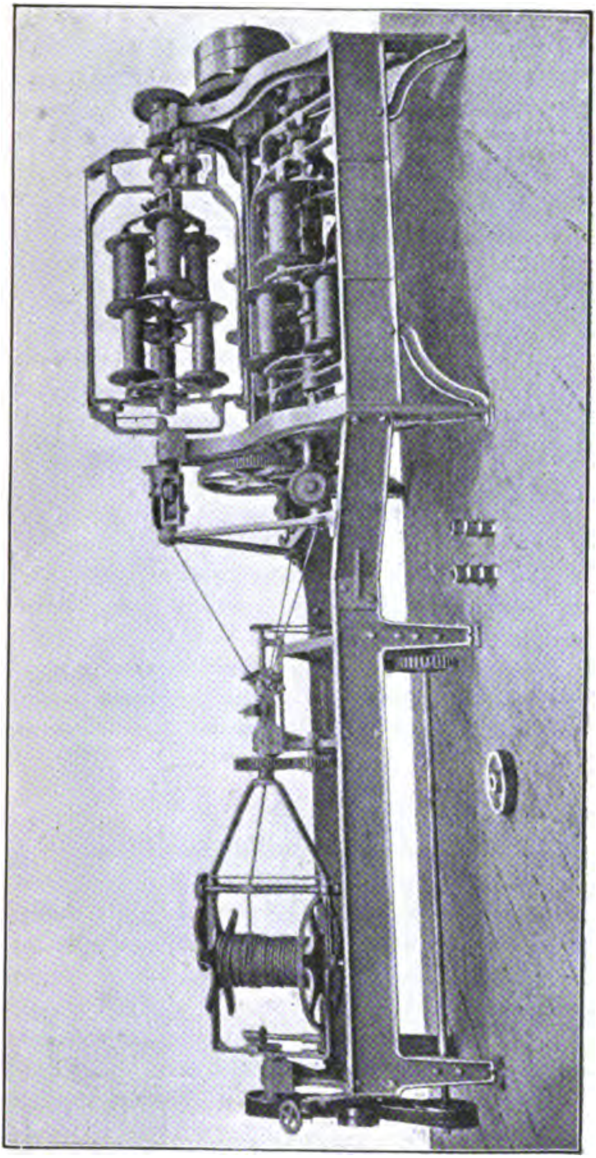


Fig. 4.

plate and brought together through a funnel-shaped metal tube into the centre of a frame containing at one end a large bobbin or reel. The frame revolves and gives the necessary twist to the yarns to form the strand, and at the same time the bobbin is geared so as to give the necessary tension to the strand and wind it off as made. The central yarns are sometimes made to pass through a trough containing oil, for the purpose of giving flexibility to and preserving the rope. The bobbins from the stranding machine are carried to the *rope-laying machines.* These machines have a revolving frame at one end, in which the bobbins are hung and so controlled by levers that when the frame turns the bobbins maintain their vertical position. The strands are taken together through a closing tube and then on to a drum, which also is geared so as to draw off the rope as it is laid or twisted together by the revolving frame. The combined machines (*see* Figure 4) have at one end three frames for yarn bobbins, which revolve and form strands; these strands are carried through a closing tube to the other end, where there is a rope-laying drum revolving in the opposite direction. The old type of rope-making machine was vertical, but horizontal machines are now general. In the old type of vertical machine three frames of bobbins—each frame holding the yarns for a strand, and by revolving on its own axis forming the strand—were at the same time carried round a common axis, thereby twisting the strands into a rope, which was drawn off by suitable pulleys. A machine of this type has been in use in one of our roperies for about 70 years, and is to-day doing excellent work.

Wire Rope Works.

Tyneside originated the wire rope industry, Newall's patent of 1840 being the first commercially successful method invented. This district still holds the principal share of the manufacture. The wire usually employed now is hardened and tempered steel wire, either "black" or galvanized. Wire rope is now produced of extreme strength and great flexibility, its principal uses being for colliery and tramway haulage, ship's standing rigging, electric cables, and bridge work. The process of manufacture of wire rope is in principle very similar to that of hemp rope. In wire rope works, however, the raw material used is non-hazardous, and there is no process previous to stranding, the individual wires, in fact, taking the place of the hemp yarns. Wire rope-making is done

on stranding machines and rope-laying machines. These machines are alike in principle. In a *stranding machine* the bobbins are hung in a revolving frame, but are so controlled by levers that they retain their vertical position when the machine is in action, thus preventing any twist in the individual wires. The wires are carried through a register plate into a closing tube, and so together on to the winding-off drum. The centre of the strand is either a wire, or else a small hemp rope or "core." When hemp rope is used as a core it is often passed through batching oil or tar to lubricate and preserve it. The number of wires in each strand varies. One type of stranding machine has a tandem arrangement; the first set of bobbins, for example, will form a strand of six wires round the central one, these seven in turn pass as a core through the second set of bobbins, which form 12 more wires round, and the 19 wires may in turn be carried through a third set which form other 18 wires round them, the strand as finally issuing from the machine containing 37 wires. The *rope-laying machines* are exactly the same in principle as the stranding machines, the main difference being one of size and weight, and the bobbins (which are kept vertical just as those in the stranding machines are) are usually only three in number. The speed at which the stranding and laying machines run depends entirely upon the weight of rope dealt with. In ordinary size stranding machines the frame will revolve 300 to 400 times per minute, while one very heavy rope-laying machine which I recently saw only made 12 to 14 revolutions per minute. Both stranding and laying machines are usually horizontal, but the old type of vertical machine is still to be met with. As the bobbins of wire are exhausted in stranding, fresh ones are put in, and the ends are either brazed by an ordinary gas blowpipe, or merely twisted together and tucked in.

To preserve the rope from rust and to add to its flexibility tarring is resorted to. With small rope the coils are dipped bodily into a tank containing the tar or rope oil. The mixture is sometimes cold and sometimes steam-warmed. It is not always simply tar; various ingredients are added, each manufacturer having his own special favourite compound as a lubricant. None of the materials used are, so far as my experience goes, more hazardous than tar. With the heavier kind of rope it is impracticable to dip in coil form; for such the plan employed is to have a tar trough, through which the rope is carried from the drawing-off drum before it is coiled up.

Having thus roughly described the processes carried on in the two branches of the manufacture, I would like to consider some points of hazard.

Hemp Works.—In Scotland and Ireland the preparatory portions of these works are rated under the Scotch and Irish Flax Mill Tariffs, and a study of the Scotch Tariff will indicate to a large extent what may be looked upon as defects in risks of this class.

With regard to construction, I have already mentioned that it is not unusual to find rope walks defective in this respect, but machine spinning, etc., buildings are usually of ordinary construction.

The ideal ropery would conform to the following description :—

1st.—Buildings all of one storey and of standard construction, with incombustible floors.

2nd.—Lighted by incandescent or approved arc electric lamps.

3rd.—Warmed by hot-water or steam pipes.

4th.—Raw material store detached.

5th.—Carding, softening, and hand and machine heckling and teasing in detached building.

6th.—Preparing and drawing rooms separate from spinning.

7th.—Spinning separate from stranding and laying.

8th.—Tarring done in a detached building, tar being heated by steam only.

9th.—All dirt and refuse removed from the premises daily, and fans provided for blowing out the light floating dust from the carding and preparing rooms into the open air.

10th.—The amount of raw material taken into the works from the store strictly limited to the amount required for the day's consumption.

11th.—No oiled material left unused overnight on the batching floor.

12th.—Extincteurs and buckets fixed in carding and in preparing rooms, so as to check at once a fire originating from any foreign body in the material under process.

The machinery used in hemp rope works is much heavier and coarser than that used in cotton and woollen spinning, and is consequently run at less speed (a spindle in a Good's machine only running at about 1200 to 1400 revolutions, as against 9000 to 10,000 per minute of a cotton mule spindle), but while there is less risk of friction from high speed, there is greater risk from dust

and dirt. The dust and refuse given off in the preliminary processes constitute the principal element of danger. In most works fans are fixed in the carding and preparing rooms to draw off the light dust, but these are only partially effective. Where manilla alone is worked, as already indicated, there is a marked diminution of dust, etc.

I have endeavoured to arrive at some conclusions as to the causes of fires in hemp roperies, from the record of fires for the past 20 years or so. Unfortunately, out of a total of some 53 fires of which I have note, in 39 cases the cause is returned as unknown. The remaining 14 are said to have originated thus: spontaneous combustion, 2; ignition of tar, 4; dust falling on light, 1; foreign material in carding engine, 1; match in heckler, 1; sparks from locos., 3; careless use of lights by mechanics, 2. I have no doubt whatever that numerous small outbreaks arise from foreign material in carding engines, which are promptly checked and for which claims are not made. Probably a large number of the fires marked "cause unknown" have started by spontaneous ignition of waste.

I think I shall be within the mark in saying that scarcely one of the existing hemp rope works of this district has escaped without a serious fire at one time or other in its existence. There has been in this class of risk a process of evolution, from the old dirty crowded place, adapted from hand spinning works, to the modern roomy, clean and well-arranged risk. The process is by no means at an end yet; there are bad risks of the class still to be found, and room for improvement in one respect or another in all.

Wire rope works are obviously much less hazardous risks in themselves than hemp works. Frequently, however, the two manufactures are carried on in the same premises, and consequently the wire department is penalised. These works are often crowded with machinery and the floors are usually dirty. The latter defect arises from the tarring and greasing of ropes and cores (and special attention should be given to the tarring arrangements), and also from the heavy lubrication which the larger machines need. In the vertical type of machine the base on which the frame revolves is often thickly coated with spent oil and grease, and I have known this start a fire. The storage of old rope and coarse bagging for wrapping round the finished coils of rope, and the occasional making of rough jute rope by hand, are points that should have attention. Storied buildings are not unusual in wire

rope works, particularly in those where the old vertical type of machine is used, but they are objectionable. An upper floor loaded with heavy machinery and material would prove a serious element in the event of a fire breaking out.

I desire to express my thanks to Messrs. Samuel Lawson & Sons, of Leeds, for permission to use illustrations of some of their machines, and to Messrs. R. Hood, Haggie & Son, of Newcastle, for specimens of rope, fibre, etc.

OWEN D. JONES.

Newcastle Insurance Institute,
23rd February, 1900.

FARMS AND FARMING STOCK.*

In this paper it is proposed to deal with the subject under consideration from a Fire Insurance point of view only, the purely agricultural aspect being deemed outside our present purpose.

In 1894 the insurable value of corn and green crops was estimated by the returns of the Board of Agriculture to be £92,332,653, hay crop £67,739,554, and live stock £249,340,524. These figures leave out of account any estimate of fruit and flax, while this stupendous value of the aggregate farming stock of the United Kingdom shows the necessity of a careful consideration of the fire hazard by Insurance officials with a view to an adequate rating by Tariff, just to the Assured and showing a fair margin of profit to the Insurance Companies.

There are at present two Farming Property Tariffs in force in the United Kingdom—the one for England, Wales, and Ireland; the other for Scotland. It will be convenient here to deal with them together, noting as we proceed such differences as exist between the two.

Farm-Houses.

Under the Tariff for England, Wales, and Ireland, the rate for the *Buildings* of thatched farm-houses is fixed at 5s. per cent., no mention being made of the rate for contents, but under the Scotch Tariff 5s. per cent. is charged for buildings and contents alike. In neither Tariff is any rating prescribed for farm-houses other than thatched, but it is customary—and very properly so—to rate them as ordinary dwelling-houses, viz.:—1s. 6d. per cent. for first class, and from 2s. 6d. per cent. for second class. Nor is there any mention in either Tariff of labourers' cottages on a farm, though, by general consent, the same rating as for farm-houses is applied.

It may be noted that no rating is provided for hop-pickers' huts, although these are found on numerous farms in the hop-

*This paper was written prior to the issue of the new Farming Property Tariff for England, Wales, and Ireland.

growing districts, and might with advantage be rated in Farming Property Tariffs, under which heading they clearly come. When it is considered that the periodical inhabitants of these buildings are drawn from the very scum of humanity—"the submerged tenth" of London—with the consequent moral hazard attaching to these insurances, it would appear advisable that Tariff rating should be applied to them in any future Farming Property Tariffs that may be issued. At present the prevailing rates on the few first-class buildings seem to be 5s. per cent., on the numerous second-class 7s. 6d. per cent., and on the third-class 10s. 6d. per cent.

Formerly, in the counties of Devon and Dorset and in part of Somerset, thatched farm-houses were, with other dwellings similarly roofed, charged much higher rates than 5s. per cent., in some cases as much as 15s. per cent. being obtained. There were no Tariff obligations for these charges, but a tacit understanding among the Offices interested made it possible to secure them. Alas, that it should be so different now! Those days are apparently gone never to return, keen and relentless competition has taken their place, rate-cutting is all the vogue, until it is to be feared that the same risks on which formerly 15s. per cent. was paid are now eagerly accepted by "progressive" Companies at 5s. per cent.

The large number of contiguous thatched buildings, with their consequent concentrated fire hazard, was the cause of higher rating in these districts, the charge being varied according to the distance of the thatched dwelling-house under consideration from other thatched buildings having chimneys—100 yards being the minimum distance for the normal rate.

Farm Out-Buildings.

All farm out-buildings are rated at 3s. per cent. under both Tariffs, regardless of construction, with the exception of those that are thatched and have a chimney therein or adjoin any building having a chimney, which are charged 5s. per cent. Tariff rates are, of course, minimum ones, and it is usual to charge 5s. per cent. for all thatched buildings, irrespective of their containing chimneys themselves or their presence in contiguous buildings. In cases of competition, however, 3s. per cent. is sometimes charged for all thatched buildings, and it is to be

feared that the presence of chimneys is sometimes conveniently overlooked, such breaches of this and other Tariffs being very regrettable. It must not be assumed that deviations of this kind are invariably made with the privity of the insuring Company. In many cases where large estates are to be insured, the agent for the landlord is also agent for the Fire Office, and, in preparing the specification for the insurance, he is not unlikely, in the absence of the specific question from the proposal form, to omit all reference to the "harmless necessary" chimney; also he is anxious to keep down the expenses as far as possible on behalf of his employer the landlord, albeit to the detriment of his other employer—the Fire Office. Has it not been said, "No man can serve two masters"?

The *buildings* of hop kilns and oasthouses, although they can be accepted under the rates laid down for farm out-buildings, are usually charged the same rates as prescribed for the *contents* under the Hop Oasts Tariff for the United Kingdom—viz., 5s. per cent. first-class, 7s. 6d. per cent. second-class, and 10s. 6d. per cent. third-class; and this is but common sense, for why should the building of a thatched oasthouse be accepted at 5s. per cent., while 10s. 6d. per cent. is charged for its contents?

The close proximity of a line of railway means, or should mean, a higher rate for thatched buildings, although there is no Tariff obligation for such increase. Any engine in a farm building for farm purposes usually involves an extra rate, no matter whether the building be thatched or otherwise. If the building itself be thatched or there be thatched buildings contiguous, the engine chimney is generally required to be fitted with a spark arrester or catcher, for reasons which are obvious.

Farming Stock.

Under the Tariff for England, Wales, and Ireland, 5s. per cent. per annum *or for a shorter period* is at present charged for agricultural produce, farming stock, and implements and utensils of husbandry, and under the Scottish Tariff 10s. per cent. By both Tariffs a steam threshing-machine is allowed to be used without extra charge, but only in the latter is it clearly laid down that threshing machinery, with the engine and boiler, are to be rated as farm implements. In this connection it may be stated that except upon large farms, or where several

farms belonging to one estate are "in hand," and the engine can be used for chaff-cutting, root-pulping, or for other purposes beside threshing, the threshing machinery usually belongs to a machinist, who travels from farm to farm. In Norfolk the custom appears to be that the machinist receives from the farmer a certain sum per coomb for threshing, and the farmer also provides sufficient coal to furnish the motive power of the engine, both during the threshing process and to convey the engine to the next farm. The portable engine, threshing-machine, and appurtenances are insured by the machinist either on his own premises or wherever they may be when let out on hire, and although the rate of 5s. per cent. might be accepted in England, Wales, and Ireland, 7s. 6d. per cent. or 10s. 6d. per cent. are frequently obtained; indeed, at the time when machinery was first introduced, and riots were common in consequence, 20s. per cent. was the current rate. In Scotland, as stated above, 10s. per cent. is the Tariff rate.

Under both Tariffs agricultural produce and implements may be insured in one sum, although the rule of some Offices is to obtain divisions.

Insurances on agricultural produce in England, Wales, and Scotland are subject to the Three-fourths or Special Condition of Average:—

> "If the sum insured on agricultural produce, either separately or in one amount with other property, shall, at the breaking out of a fire, be less than three-fourths of the value of all the property insured in that amount, then the Assured shall be considered as being his own insurer for the difference between the sum insured and the full value of the property insured at the time of the fire, and shall bear a rateable share of the loss accordingly"—

and in Ireland to the *Pro-ratâ* clause:—

> "Whenever a sum insured is declared to be subject to Average, if the property covered thereby shall, at the breaking out of any fire, be collectively of greater value than such sum insured, then the Assured shall be considered as being his own insurer for the difference, and shall bear a rateable share of the loss accordingly."

Prior to the issue of the initial Tariff in 1861, live and dead farming stock were frequently insured in one sum, but at the period immediately anterior to the Tariff coming into force, there appears to have been some understanding that a separate sum should be placed on live stock. In these old policies the limit on

any one animal does not seem to have been inserted, and the Average Clause is generally conspicuous by its absence.

The gradual increase in rating will be noted on looking through old policy registers. As experience showed the existing rates to be inadequate, we find that from 2s. per cent. in 1821 they rise to 3s., 4s., 4s. 6d., and finally to 5s. per cent., which seems to have been the more or less regular charge till the varying quotations crystallised in the first Farming Stock Tariff in the rate of 5s. per cent., which remains to the present day for England, Wales, and Ireland, and was charged up to 1894 for Scotland. Doubtless the rise and increase of machinery—which in its primitive form must have been specially dangerous—as well as the cheapening of matches, were in some part responsible for the periodical raising of rates.

Under the Tariff for England and Wales, farming stock may be accepted at 4s. 6d. per cent. if the insurance be made subject to the *Pro-ratâ* Condition of Average, but farmers do not appear desirous of taking advantage of this section of the Tariff, as the premium on the larger sum which it would be necessary to insure in order to obtain payment of any loss in full under the system would be more than under the Three-fourths Average clause. Thus:—

Value of property, ...	£1000	0	0
Fully insured under P.R. Clause at 4s. 6d. per cent. ..	Premium, 2	5	0
£750 insured under Three-fourths Clause at 5s. per cent. ..	Premium, 1	17	6

Although no limit is fixed by either Tariff on any one implement or utensil of husbandry, nor is it stated by what power they may be worked at the normal rate, except in the Scotch Tariff, it is the rule of Offices to exclude from the items covering implements those worked otherwise than by hand or horse power, and some Companies place a limit of £40 on any implement or utensil. Some offices issue policies covering machinery worked by steam in one item, but the safer plan is to require each machine to be insured under a separate item, also stating for what purpose it is used—for instance, oat crushing, bean splitting, &c.

At the heading of the Tariff for England, Wales, and Ireland it is stated:—

> "If any process of screening or smutting of grain, or dressing of flour, be done by steam power on a farm in

England or Wales, the building and contents of any portion of the premises in which any one or more of these processes is carried on are to be rated under the Corn Mills Tariffs (England and Wales) No. 1 or 2."

It is, however, very rarely that such processes are carried on upon farms, for nowadays even the water or wind corn mills—at least those in England which contain only stones—are little more than grist mills, and dressing of flour is no longer carried on therein.

Although not stipulated in the Tariff, it is usual to require a separate sum to be placed on the agricultural produce on each farm, where two or more farms are under cultivation by the same person, except when such farms are contiguous and worked as one; implements and live stock, on the other hand, which are liable to be moved, according to circumstances, from one farm to another, are insured in gross, irrespective of the contiguity of the farms.

Under the Tariff for England and Wales the following memorandum, which explains itself, appears:—

> "*Memo.*—Hops in farm buildings (excluding hop oasts and stowages communicating therewith for any time during which fires are alight in the furnaces appertaining thereto) may be insured for any period not exceeding three months at a rate of not less than 2s. 6d. per cent., and, provided such insurance be limited to any specified single building, the policy may be granted without any Average Condition."

These short-period insurances are very largely effected by growers during the latter part of the season, and as they usually extend to cover hops stored in several buildings, the Three-fourths clause appears on such policies, which are, of course, supplementary to any farming stock insurances which may be in force, such insurances covering hops not undergoing any process of drying by the item on agricultural produce.

Wool in farm buildings may be insured separately in England and Wales at 3s. per cent., and in Scotland at 5s. per cent., but advantage is seldom taken of this lower rating. A large experience of farming stock insurances, in the case of an Office giving a separate item for wool on its proposal form, recalls but few instances of farmers placing a specific sum thereon, proposers generally preferring the wool to be included in the item covering agricultural produce.

Under the Tariff for England, Wales, and Ireland, insurances may be granted on roots not stored in buildings and on growing crops, by separate items without the Average clause, while, in the Scottish Tariff, the following instruction appears :—

> "In every policy covering 'Agricultural Produce' a clause must be inserted stating whether roots not stored in buildings and growing crops are, or are not, included in the insurance under the term 'Agricultural Produce'."

In England, Wales, and Ireland the farmer does not seem to think it worth while to place a specific amount on roots to avoid their coming under the operation of the Average clause, there being practically no fire risk on roots in the open, whether growing or when "haled up" (or banked up) as it is called in Norfolk. Indeed, some farmers prefer to have roots excluded from the item insuring agricultural produce, so that in the event of a loss occurring on, say, hay stacks, the value of the root crops will not be included in the Assessor's estimate of gross value for the application of the Average clause. It may be noted here, too, that growing crops are sometimes not insured at all, but in the majority of policies they are included in the item on agricultural produce. Where, however, a line of railway runs through a farm, a separate sum is occasionally given on crops growing within a certain distance (usually 100 yards) of the line, such item being charged a higher rate, whilst the other growing crops, outside such limit, are included under the ordinary farming stock item at the normal rate.

Notwithstanding that the England, Wales, and Ireland Tariff states that insurances on agricultural produce in any specified single building or on any specified stack may be granted separately without the same being subject to Average, one or two Offices place the Three-fourths clause upon policies covering single stacks in England and Wales, and the *Pro-ratâ* clause on similar policies in Ireland.

Whilst dealing with the subject of stacks it will not be out of place to state that hay dealers' floating insurances on stacks in England and Wales are usually subject to the *Pro-ratâ* clause, not the Three-fourths Condition of Average, and are rated at 7s. 6d. per cent. and upwards. Where the policy extends to cover stacks within 12 miles of the Royal Exchange, London, or within a few miles of other large towns, higher rates are charged.

Live stock are rated under the Tariff for England, Wales, and Ireland at 5s. per cent., and under that for Scotland at 3s. per cent., the following self-explanatory clause being found in each Tariff:—

> "All insurances on live stock must be by a separate item or items. If live stock are insured in one item, then in case of loss no animal is to be deemed of greater value than £40; if horses or cattle are insured in an item by themselves, then the limit of value payable on each horse or each head of cattle so insured may in case of loss be raised to £100, but in that case horses and cattle so insured must be excluded from the general insurance on live stock. If it is desired to insure any horse, bull, ox, or cow, for more than £100, or any other animal for more than £40, such horse, bull, ox, cow, or other animal must be specifically described and insured by itself for a stated sum."

Live stock, when desired by the Assured, are insured while out at agistment or depastured on land away from the farm, without any divisions being demanded in the live stock item.

Fire Risk.

During the last few years farming stock business has not proved profitable to the Offices. In Scotland it was found necessary in 1894 to increase the rate for agricultural produce and implements from 5s. per cent. to 10s. per cent., the live stock rate being reduced from 5s. per cent. to 3s. per cent., and it seems almost certain that some increase must shortly be made in the charges for England, Wales, and Ireland. Even a non-tariff mutual Office—the Essex and Suffolk—in its directors' last annual report stated that the losses paid on farming property had exceeded the premiums received, and that the question of a revision in rating would have to be taken into serious consideration.

The following appeared in the columns of the *Scottish Critic*:—

> "Farm fires were too common in 1898. Of fires at farms involving more than £40 damages, no fewer than 713 took place, of which 567 were in England, 17 in Wales, 103 in Scotland, 25 in Ireland, and 1 in the Isle of Man. In Scotland, Forfar had 16, Aberdeen and Perth 12 each, the other counties having under 10. Of the 713 fires, 210 took place in the first six months. The hay season inaugurated the great increase, and the highest month was September, which

was responsible for nearly 20 per cent. of the total. The loss is estimated at £308,573. This is an alarming farmers' bill for one year's fires."

The excessive losses in 1898-9 were doubtless due to the abnormally dry summers. Owing to the absence of rainfall, the stacks were unusually dry, as were the straw and litter in the farmyards, while the corn in the swaith (that is when cut and lying in rows) was so dry that in some cases it was set on fire by passing trains. The water pits on the farms were dried up and the water-butts empty for weeks together, and in Norfolk the farmers were obliged in some instances to cart water for the live stock from a distance of two or three miles. The scarcity of water naturally militated against the fire brigades, sometimes rendering their efforts quite abortive, with disastrous results to property and to the coffers of the Fire Offices.

Spontaneous combustion, caused by the stacks being got up in a green or damp state, is a prolific cause of fires, especially in wet summers, and although such losses (if confined to the overheated stacks) are not covered by the Offices, fire brigade charges have to be paid. Then, too, these self-kindled stacks often set fire to others which come within the terms of farming stock policies, and it may be parenthetically remarked that the Assessor, in valuing for the purpose of applying the Average clause, does not include the stacks directly fired by spontaneous combustion. In cases, however, of heavy rainfall or floods causing overheating, *followed by fire*, the Insurance Offices are liable.

By far the most frequent cause of fires is children playing with matches. Boxes of these may be obtained at eight a penny, and they are consequently left about very often within easy reach of the little ones, who, amusing themselves therewith, even in the stack-yard or harvest field, become in only too many cases "innocent incendiaries." In warm weather, tramps shunning the hot casual wards with their enforced oakum-picking or other labour on the following morning, seek an *al-fresco* couch in close proximity to a stack, where, dropping asleep with pipe still burning, they inflict losses, more or less heavy, upon the Fire Offices. Discontented labourers find in stacks an easy and comparatively safe means of paying off real or imaginary evils by incendiarism, and even if the offenders are detected and convicted the Office has to meet the loss.

Traction or portable engines passing along the roads sometimes fire stacks and thatched buildings. The custom in these cases is

for the Companies to reimburse the assured, whose rights are then subrogated to them, but it is often found impossible, even upon distraint, to recover large amounts from the machinists. Several expensive and protracted suits have been fought to test the liability of railway companies for fires caused by passing trains, but invariably without success. The Law Courts in England and Scotland (confirmed by the House of Lords on appeal) have decided that where a railway company has adopted every means of a mechanical nature in the construction of its engines to prevent the emission of sparks, it is not liable for fires accidentally occurring consequent upon such sparks having been emitted, and it is next to impossible for the Insurance Office to satisfactorily prove that the railway company has not taken "all reasonable precautions."

Owing to the accidental presence of a stone or other hard substance in the machinery, threshing-machines have sometimes caused fires while at work, for as the machine stands behind or alongside the corn stack when threshing, and deposits the straw on the other side of the machine, the least spark is likely to prove disastrous.

Hay dealers' floating insurances have not proved a remunerative class of business to Offices generally, although, as has been already stated, they are usually charged more than the normal rate for farming stock, and are subject to the *Pro-ratâ* instead of the Three-fourths clause. It is open to doubt whether the farmer exercises the same watchful supervision over the stacks in his homestead when they have passed out of his hands and are standing at another man's risk.

Insurances on farm-houses and farm out-buildings have not been unprofitable, the fires occurring being mostly due to lightning, proximity of stacks, men smoking, and children playing with matches.

Implements and utensils would appear to be the least hazardous of all, partly owing to their being left out in the fields; and, even when in farm buildings, the carts, waggons, etc., can frequently be drawn out when in danger from fire and removed to a place of safety. To some extent the smallness of the fire risk is counterbalanced by the fact that the Three-fourths Average clause is not applied in England, Wales, and Scotland, where implements and utensils are insured separately, or when they are covered in one sum with the agricultural produce and comprise the only property destroyed.

Live stock insurances appear to be profitable at 5s. per cent., although losses are somewhat numerous, and are due mostly to lightning when cattle are grazing, the claims being naturally heavier in districts where storms are frequent. It is probable, however, that such losses average under £30 each, as it is rarely that more than two or three of the same flock or herd are simultaneously killed by the lightning flash. The Three-fourths clause or the *Pro-ratâ* clause is not applied here, but only the limit of value on any one animal inserted, and farmers usually do not insure for more than one-third of the gross value, or say up to the total value of the live stock confined in buildings at the homestead during the winter months.

General Remarks.

It will be seen from remarks in an earlier part of this paper with reference to some Offices accepting insurances on agricultural produce and implements and utensils of husbandry in one sum, while others require divisions, that there is a regrettable lack of uniformity with regard to farming stock proposal forms and policies; indeed some Offices have themselves more than one form of wording.

In the case of one Company the wording of the proposal form and policy are almost identical.

A few samples of different proposal forms are appended for comparison:—

1. On agricultural produce, inclusive of growing crops, fruit, wool, cheese, cider, together with manures, artificial and other food for cattle, grown or to be used on the Assured's farm, consisting of .... acres of arable and .... acres of pasture, situate in the parish of ...., in the county of ...., and called ....

   N.B.—Stacks or other farming stock placed, and crops growing within 100 yards of any line of railway, vessel or tank for dipping hop poles, lime or brick kilns, or hops and grain undergoing any process of drying, are not covered by this insurance unless specially mentioned and agreed to.

No steam engine used on any farm must be worked without an ashbox, or be fed with any material for producing heat other than coal or coke, otherwise this insurance will become void.

Steam engines on farms may be used for threshing corn and pulse, chaff cutting, pulping roots, breaking oilcake, and bruising oats or other food for cattle by steel rollers or steel grist mills; but not for

grinding corn or pulse by stones, sawing timber, or threshing, breaking, heckling, or scutching hemp or flax, unless specially allowed on the face of or by endorsement on the policy.

On growing crops within 100 yards of any line of railway on said farm.

On implements and utensils of husbandry worked by hand or horse power only on said farm, for which not more than £40 shall be paid for loss on any one article.

N.B.—Engines and machinery worked by steam, wind, or water power must be mentioned and insured separately. No fixed steam engine must be placed in or near a thatched building without notification to this Society.

On live stock on said farm, for which not more than £40 shall be paid for loss on any one animal.

N.B.—If live stock are insured in one item, then in case of loss no animal is to be deemed of greater value than £40; if horses or cattle are insured in an item by themselves, then the limit of value payable on each horse or on each head of cattle so insured may in case of loss be raised to £100, but in that case horses and cattle so insured must be excluded from the general insurance on live stock. If it be desired to insure any horse, bull, ox, or cow for more than £100, or any other animal for more than £40, such horse, bull, ox, cow, or other animal must be specifically described and insured by itself for a stated sum.

On wool on said farm.

N.B.—Wool in farm buildings, if separately insured and excepted from the general insurance on agricultural produce, may be covered for a year or for any shorter period at a rate of not less than 3s. per cent.

Cancelled No., if any, to be stated here ....

Memo.—Insurances may be granted on roots not stored in buildings and on growing crops, by separate items, without any Average condition. Insurances on agricultural produce in any specified single building, or on any specified stack, may be granted separately without the same being subject to any Average condition. Hops in farm buildings (excluding hop oats and stowages communicating therewith for any time during which fires are alight in the furnaces appertaining thereto) may be insured for any period not exceeding three months at a rate of not less than 2s. 6d. per cent., and provided such insurance be limited to any specified single building the policy may be granted without any Average condition.

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2. On the following property on his farm situate at ...., in the county of ...., and known as .... farm, containing .... acres, viz., ... acres arable land, ... acres pasture.

On agricultural produce and farming stock only (live stock excepted).
On implements and utensils of husbandry only.
On live stock only (not more than £40 allowed on any one animal).
On thrashing mill driven by ... . power.
On steam engine and boiler.
Horses may be insured with a £60 limit if they are excluded from the general item of "live stock," and separately insured.

N.B.—Growing crops (unless specially mentioned), hops drying in hop oasts or kilns, barley undergoing malting, and any other articles in process of manufacture, and machines worked by steam, water, or wind are not included under the terms agricultural produce and farming stock. Ricks, stacks, and property in thatched buildings within 100 yards of any line of railway, or of any tank or vessel for creosoting hop poles, are not insured unless specially mentioned.

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3. On agricultural produce, implements and utensils of husbandry, and farming stock, exclusive of live stock, but including growing crops, fruit, wool, cheese, cider, manures, and food for cattle on Insured's farm only, situate in the parish of ...., in the county of ...., and called ....
On live stock (exclusive of horses) on the said farm; no one animal in case of loss to be valued at more than £40.
On horses on the said farm; no one horse in case of loss to be valued at more than £100.

Definition of Terms of Policy
(given on Proposal Form).

The insurance by this policy does not include the following unless specially mentioned on the policy, and insured in separate and distinct items:—

I. Steam engines and their appurtenances, nor machinery worked by steam.

II. Hops and grain in any oast or kiln while fire-heat is being used therein, or in any building adjoining any such oast or kiln, and not separated therefrom by a perfect stone or brick wall; nor barley under process of malting.

III. The contents of any building in which hemp or flax is scutched or dressed, or in which screening or smutting of grain or dressing of flour is done, or in which timber is sawn by machinery, nor the contents of any building adjoining another building and not separated therefrom by a perfect party wall of brick or stone, in which any of such processes may be performed.

IV. Tanks and vessels (with the material contained therein) for dipping hop poles, nor farming property within 100 yards of any such tanks or vessels, or within 60 yards of any line of railway.

In addition to obtaining the division in amounts required by his Office, the agent is also requested to supply answers to a number of questions (usually fourteen or fifteen), the following being in effect some of those generally required by the Companies:—

How long have you known the proposer, and are you satisfied as to his respectability?

Has he ever had a fire? If so, give particulars.

How many homesteads or separate premises are there on the farm?

Are any of the farm buildings thatched? If so, give particulars.

Is it the practice on this farm to accumulate the produce at the homestead, or is it usually stacked in separate parts of the farm? If so, how many different stackings are there?

Is there on the farm any mill, kiln, or any tank or vessel for creosoting or dipping hop poles?

Is any machine worked by steam power ever used on the farm? If so, state whether fixed or movable, and if used for threshing only or for what other purposes.

Is there any railroad on or near the farm? If so, state the nearest distance from any stack or thatched building.

What is the probable amount the Office might lose by any one fire under this insurance?

Has there been any incendiary fire in the neighbourhood? If so, when?

In order to see how far the policies themselves differ, note the following examples:—

[A] On agricultural produce, inclusive of growing crops, fruit, wool, cheese, cider, together with manures, artificial and other food for cattle grown or to be used on Assured's farm, consisting of .... acres of arable and .... acres of pasture, situate ....

N.B.—Stacks or other farming stocks placed, and crops growing within 100 yards of any line of railway, or of any tank or vessel for dipping hop poles, or hops or grain undergoing any process of drying, are not covered by this insurance unless specially mentioned and agreed to. No steam engine used on any farm must be worked without an ash box, or be fed with any material for producing heat other than coal or coke, otherwise this insurance will become void. Steam engines on farms may be used for threshing corn and pulse,

chaff-cutting, pulping roots, breaking oilcake, and bruising oats or other food for cattle; but not for grinding corn or pulse, sawing timber, or threshing, breaking, heckling, or scutching hemp or flax unless specially allowed on the face of or by endorsement on the policy.

On growing crops within 100 yards of any line of railway on said farm.

On implements and utensils of husbandry worked by hand or horse power only on said farm.

On live stock on said farm.

N.B.—In the event of loss through accident by fire, not more than £40 shall be paid upon any one animal, implement, or utensil of husbandry unless specially insured for a larger sum.

(Three-fourths condition of Average.)

[B] On agricultural produce and farming stock (live stock excepted), implements and utensils of husbandry worked by hand or horse power only in the offices of or on the Assured's farm, situate..........., subject to the annexed special condition of average.

On live stock on said farm, for which not more than £40 shall be paid for loss on any one animal.

Warranted that the property mentioned in first item hereof be distant not less than 100 yards from the centre of the nearest railway line.

(Three-fourths condition of Average.)

[C] On agricultural produce and farming stock (except as undermentioned), subject to the additional condition printed at foot hereof.

On implements and utensils of husbandry (except machines worked by steam, water, or wind).

On live stock (no one animal to be deemed of greater value than £40).

All on the Insured's farm called ...., situate ....

Additional condition.—If the sum insured on agricultural produce, either separately or in one amount with other property, shall at the breaking out of a fire be less than three-fourths of the value of all the property insured in that amount, then the Assured shall be considered as being his own insurer for the difference, and shall bear a rateable share of the loss accordingly.

The insurance by this policy does not include the following unless specially mentioned in the policy, and insured under separate and distinct items:—

I. Hops and grain in oasts or kilns while fire-heat is being used therein, and any article in process of manufacture, and growing crops.

II. The contents of any building in which hemp or flax is scutched or dressed, or in which any screening or smutting of grain or dressing of

flour is done, or in which timber is sawn by machinery, nor the contents of any building adjoining another building, and not separated therefrom by a perfect party wall of brick or stone, in which any of the processes may be performed.

III. Tanks and vessels (with the material contained therein) for dipping hop poles.

IV. Ricks, stacks, or property in thatched buildings within 100 yards of any such tank or vessel, or within 100 yards of any line of railway.

V. Engines or machines worked by steam, water, or wind.

N.B.—Portable steam engines may be used on the farm provided coal or coke only be used as fuel, and provided all due precautions be observed in having the funnel guarded by wire-gauze and the firing place provided with a proper ash-box.

[D] On agricultural produce and farming stock (live stock excepted), implements and utensils of husbandry on the Insured's farm, known as ...., and situate ....

On live stock on said farm (in the event of loss no one animal to be deemed of greater value than £40).

Warranted that no screening or smutting of grain or dressing of flour be done by steam power upon the said farm.

Memo.—The above terms are understood to cover the whole produce of crops in ricks, stacks, barns, stables, and all other farm buildings on the farm named, also all implements of husbandry thereon (except steam engines, boilers, and machinery of threshing mills), and all live stock in the farm buildings and farm yard at the time of accident, but not growing crops, nor grain in kilns or mills, nor barley under malting, unless by special agreement.

Note.—The above property, whether on field or in thatched buildings, warranted not within 100 yards of any line of railway.

(Three-fourths condition of Average.)

[E] On agricultural produce, not including growing crops, nor wool, nor hops nor grain in oasts or kilns, or in any building communicating therewith.

On farming stock, not being agricultural produce or live stock, and on any implements and utensils of husbandry that are not worked by steam.

On horses, not exceeding £100 on any one animal.

On other live stock, not exceeding £40 on any one animal.

All on farm called .... farm, and containing .... acres, situate ....

It is warranted that no fixed machine worked by steam power shall be used on the farm aforesaid.

Memo.—This insurance will not extend to cover any ricks or stacks within 100 yards of any railway, hop pole dipping tanks, or other hazardous risk.

(Three-fourths condition of Average.)

With regard to the distance from lines of railway within which Companies are willing to insure agricultural produce at the normal rate, although some Offices, as shown in the foregoing examples, fix 100 yards, this is by no means the general rule, but may be regarded as the maximum distance within which extra rates are levied. Some, as has been seen from proposal No. 3, are satisfied with 60 yards; while ricks at a homestead or in stackyard at 30 yards' distance from a railway line, running in a deep cutting, have been accepted by a Company at the normal rate.

It appears to be generally agreed, and stated either on the face of the policy or in its conditions, that steam engines on farms must not be worked without an ash-box, or use any material for producing heat other than coal or coke; and also that produce within 100 yards of any vessel or tank for dipping or creosoting hop poles is not insured unless specially mentioned and agreed to.

While not venturing to suggest for general adoption either a proposal form or specification for farming property policies, it seems to me highly desirable that, as in the case of other Tariffs, the Fire Offices' Committee should in any future revision formulate and issue a Tariff proposal form, with divisions and wording to be adopted by all the Associated Offices, and with warranties as to screening or smutting of grain, distance from line of railway, etc.

In this paper it has been sought to be practical and concise, and many points merely touched on here might have been discussed at greater length with advantage; indeed, so important and far-reaching are the Insurance bearings of Farms and Farming Stock that it is surprising so few notes on the subject have as yet found their way into print.

C. R. QUINTON.

Norwich Insurance Institute,
23*rd April*, 1900.

SOME NOTES ON CORN MILLING MACHINERY.

As a preface to my remarks this evening, I will, with your permission, indicate the considerations which have prompted me to take Corn Milling Machinery as the subject thereof.

Although at the time well acquainted with most of the machinery used in the manufacture of textile fabrics, and conversant with a great variety of other risks, the difficulty I experienced in making a just report on my first survey of a roller flour mill remains very vivid on my mind. The plan of the buildings was very soon made, but taking a description of the processes carried on in them was altogether a different affair; scalpers, bran dusters, some forms of purifiers and dressing machines, have much the same external appearance, and to one not intimately acquainted with them the difference seems to be only one of size. Hitherto, when face to face with a machine I had not met before, I had almost always been able to find out its character by a close examination of its working parts, but my attempts to see what was going on inside these box-like machines were discountenanced by the person who was with me as being sure to damage, in some cases the machine, and in others, and more frequently, myself, or rather my clothes; at any rate, I was debarred from seeing the "wheels go wound," and had to smother my annoyance, feeling that I had no option but to take all that was told me as being correct without being able to confirm it by personal observation.

After such an experience, which, by the way, I found was not at all uncommon, you will not be surprised to know that I endeavoured to obtain further information, and I purpose laying before you to-night some notes describing in more or less detail the principal machines found in a modern corn mill, their construction, and the purposes for which they are used, in the humble hope that they may be of use to someone, who may thereby be saved from experiencing the feelings I have described.

The consideration for a moment of the physical structure of the wheat berry may assist us somewhat in understanding the use of the various machines we have to review, and although the tables of analysis quoted by various writers do not altogether agree, probably on account of the large number of differing kinds of wheat, we may take that of Mege-Mouries as being sufficiently accurate for our purpose. It is as follows:—

The 1st or outer skin, or Epidermis	0·5	of the grain	Offals.
„ 2nd skin, or Epicarp	1·0	„	
„ 3rd „ Endocarp ...	1·5	„	
„ 4th „ Testa	2·0	„	
„ Embryo, or germ	2·0	„	
„ Embryo membrane	3·0	„	
„ Endosperm	90·0	„	
	100·0		

Perhaps the most convenient order for our purpose will be to follow the wheat in its progression through the mill, beginning with it as stored, just remarking in passing that in many of the highly equipped mills the labour of receiving, weighing, hoisting, and storing in places convenient for after working, is nowadays greatly facilitated by the use of elevators, automatic scales, and travelling bands.

The wheat, as received, has with it a varying quantity of substances foreign to itself, such as weevil, sand, seeds, iron, wire, stones, gravel, and the like. The first process, that of cleaning the wheat, consists of the removal of these impurities, and it is effected by riddling, scouring and brushing under exhaust, and by washing. As a preliminary to storing, the wheat is most frequently run through a "warehouse separator," of which there are many forms in use, but all have in common some arrangement of vibrating riddles, and air currents. Fig. 1 illustrates the one I propose describing in greater detail.

The grain falls first in a thin stream on a raised platform, and during its descent a current of air passes through, removing the fine floating dust; the sieve frame, of which this platform forms part, contains two sieves and two trays, and on its passage over the sieves the wheat is freed of all coarse impurities; on its further descent from the sieves the grain is subject to strong currents of air, which further remove all chaff and straw. The fan, which is usually (as in the figure) mounted on the machine, exhausts into a suitable receptacle near.

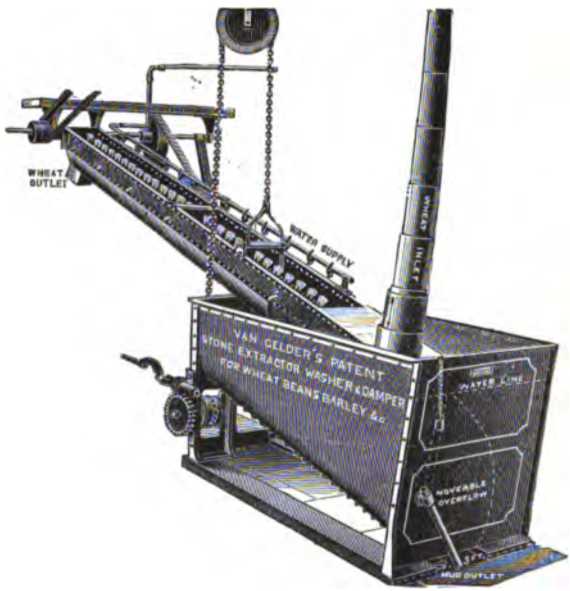

WHEAT OUTLET
WATER SUPPLY
WHEAT INLET
VAN GELDER'S PATENT
STONE EXTRACTOR WASHER & DAMPER
FOR WHEAT BEANS BARLEY &c.
WATER LINE
MOVEABLE OVERFLOW
MUD OUTLET

Fig. 3.

We now come to the Wheat Cleaning proper; the first machine, an aspirator, being simply any mechanical arrangement by which the wheat in passing over sieves is subjected to air currents which extract impurities lighter than the wheat berry. The wheat next passes through grading machines, and cockle and barley separating cylinders, these being all slowly revolving metal cylinders, with, in the one case, perforations, and in the other, indentations, of various dimensions by which the wheat is either graded into different sizes, or has extracted therefrom the cockle, barley, and rye grains, according to the shape and size of the perforations and indentations.

The scouring and smutting machines next claim our attention, and we have at once an almost endless variety; their use is chiefly to break up any lumps of dirt left from previous machines, and to rub or scour off any husks and impurities adhering to the grain. The vertical smutter, with which we were so familiar only a few years ago, is, I am told, fast giving place to the horizontal type, and this is a good feature from a Fire Insurance point of view, owing to the greater accessibility of its working parts, particularly the bearings, and to the fact that the fan has not necessarily to be placed in a dangerous position; in the vertical form the fan was usually on the top of the vertical spindle of the machine, so that, as the beaters scoured the grain, the resulting dust, dirt, &c., were drawn upwards and through the air trunks into the stive, as was also any spark either from the beaters or the bearing.

The newer type of scourer consists, then, of 8 or 10 beaters, 22 to 36 in. long, set horizontally, driven very fast within a smooth perforated case, fitted with a fan for exhausting the dust, dirt, &c. The scouring process is followed by a brushing process performed in machines similar to the scourers (*see* Fig. 2), in which, however, the beaters are replaced by brushes to polish the grain and remove all dust, fluff, or beard.

We have next to consider the wheats, principally Indian or Russian, which no amount of aspirating, scouring, or brushing will free from the dirt and stones by which it is accompanied; the former has been compared to concrete in hardness, and it is certainly hard enough to resist the breaking action of the scouring beaters. It is evident, however, that they *must* be removed or we cannot get pure flour, for there is no process by which they can be eliminated after the wheat grains have been broken; it is therefore found necessary to *wash* the wheat.

A very ingenious machine for the double purpose of washing and stoning has been invented by Mr. Van Gelder (Fig. 3). Immediately behind the telescope feed pipe is a stone box which may be shut off from the washing screw by means of slides; two of these slides are so arranged as to be capable of crossing each other and thus enlarging or decreasing the stoning aperture at the will of the attendant; upon the correct manipulation of the slides depends the quality of the work, but there is a point at which stones fairly free from wheat may be obtained. It will be observed that the feed pipe is near the end of the worm; the nearest worm paddle is also within about one inch of the inner slide. The wheat, as it strikes the water, is probably floated away from the feed, and just far enough to avoid the current which sends the stone out through the opening into the box. The nearest paddle, in clearing the water, evidently causes a current in the direction of the feed end, and presumably it is this back flow which catches the stone as it descends from the floating wheat, and gives it the necessary impulse through the end, whence it falls into the stone box.

This machine is followed by a whizzer, which acts on the principle of the well-known Centrifugal Hydro-Extractor, and is similar in construction. In treating Russian wheats, and such others as are of a highly glutinous nature, the whiz has to be supplemented by further drying, some arrangement of applying air, heated either by a kiln (outside) or by steam, being generally used.

I must not leave this section of my subject without mentioning the importance, from an insurance point of view, of there being in every mill an efficient system of magnets for the elimination of metallic substances; some milling engineers recommend the use of *one* elaborate machine, but I am inclined to think it preferable to have a less elaborate arrangement fixed in a convenient place in each of the spouts through which the wheat passes to the screens; the grain is thereby exposed to the action of the magnets at various stages, and any fragment of metal which may have become detached from one or other of the machines in the cleaning plant may become arrested.

We must now pass on to consider the machinery employed in the actual production of flour, and, as the miller has, by stress of competition, and in the effort to secure a *white* flour, been compelled to discard his old servant the mill stone, so must we, through want

of time, pass her by to examine the newer system of gradual reduction by the action of rollers.

The production of flour is divided into five systems, each as it were separate, but each dependent upon the other, viz.—1st, the break system, *i.e.*, the cracking of the berry to facilitate the removal of the skins and such like impurities; 2nd, the treatment of the chop, *i.e.*, separating the break flour from the semolina and middlings, and grinding the latter into suitable sizes for purification; 3rd, the purification, *i.e.*, the actual removal of such impurities; 4th, the reduction, *i.e.*, the grinding of the sound and pure kernel; 5th, flour dressing.

The Break System.

The wheat is first brought to a set of rollers (Fig. 4) having grooved surfaces, the feed being carefully regulated to ensure each grain coming between the "bite" of the rollers; the rollers travel at different but not at all great speeds, and the wheat is thereby subjected to a shearing, rather than, or at any rate in addition to, a crushing action; it is then conducted by means of spouts to an elevator, which carries it up to the scalper.

Discs and dismembrators are also in some, but very few, mills used for the first break; the discs are just circular plates with furrowed surfaces, which, revolving against each other, crack the wheat fed between them; the dismembrators are similar plates, but they, instead of the furrows of the disc, are fitted with a number of pins set in concentric circles; one plate revolves, the other is stationary, and the wheat is broken by being dashed between them.

The scalper is a machine for removing the break flour and middlings which have been loosened by the rollers; it is simply a revolving wire-clothed cylinder, or a rotary sieve. I am told that the sieve form of machine is fast gaining ground in the favour of millers, and I will take one of the most improved forms thereof for illustration (Fig. 5). Two sieves, suitably mounted, one over the other, are moved by two crank shafts, the broken wheat is fed into the hopper and passes along the top sieve, the coarse material tails over and falls through the louvres below, these being acted upon by an exhaust. The outsifted chop which passes through the top sieve slides along an intermediate tray, and falls upon the lower sieve; it is there divided into flour, which sifts through and

passes away by a receiver placed thereunder, the semolina tails over and falls through a further set of louvres, being likewise subject to an exhaust; the exhaust dust settles in the chambers between the two sets of louvres, or is collected by some separate machine such as the cyclone or tornado.

These processes of rolling and scalping are repeated four, five, or six times, according to the size of the mill, or the inclination of the miller, each time with rollers of increased fineness of groove.

The Treatment of the Chop

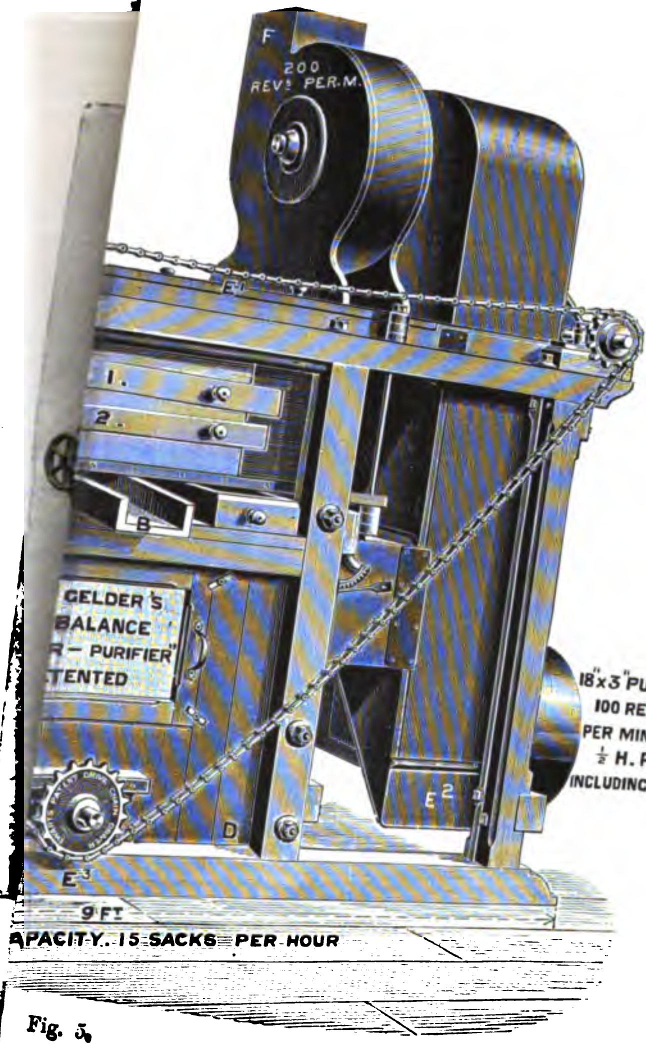
consists, as I have said, of the separation of the break flour from the semolina and middlings, and grading the latter into sizes suitable for purification; in the special scalper I have described, this separation is to some extent, if not altogether, effected, but the simpler forms of scalper have, for this purpose, to be supplemented by reels and centrifugals, the same in construction as those used for flour dressing, and which I shall presently describe in detail.

The Purification

of the unseparated break-meal is a delicate operation, and its consideration is as important to us Fire Insurance people as it is to the miller and his engineer. In this country it is the custom to divide purifiers into two groups—one, the gravity or aspirating, which includes all machines wherein air currents are applied *direct* upon the material to be treated; the other, the sieve purifiers, comprises all such patterns as provide for air to be drawn through a silk cloth whilst the material is passing over it.

All the best purifiers have, in common, the principle of employing air draughts to make a separation between the lighter and heavier products.

The stock for purification contains all the bulk of the kernels of the wheat, and in size ranges from coarse semolina to dunst middlings. Until very recently, it was generally accepted that the coarsest semolina was best treated on a gravity purifier, but that for the finer stuff those of the sieve type were the best; the newer and better of the sieve form of machine lately introduced seem, however, to be doing such good work on all kinds of stuff that millers anticipate that, although the gravity principle may be


F
200
REVS PER.M.
1.
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B
GELDER'S
BALANCE
R – PURIFIER
TENTED
18"x3" PULLEY
100 REVS
PER MINUTE
½ H.P.
INCLUDING FA
E2
D
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9 FT
APACITY. 15 SACKS PER HOUR

Fig. 5.

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retained tacked on to a sieve purifier as in the "Victoria" and "Omega," its days as a separate machine are numbered; we will, however, examine the principle of its construction.

I refer you to a sketch (Fig. 6) showing a sectional elevation of part of one air chamber belonging to a typical gravity machine. A smooth and regular flow down through the louvres in the chamber A is operated upon by a carefully-arranged air current, the plates B, C, which have fine edges, being adjusted by means of handles and screws at the side, so as to allow of the lighter portions being carried just over B, and the lightest impurities over C.

The sieve type of purifier being the most commonly used, I purpose describing in detail four machines of this type:—The "Koh-I-Noor," patented by Messrs. G. and T. Parkinson, of Doncaster, and made by Messrs. T. Robinson & Son, of Rochdale; the "Reform," patented and made by Mr. Hy. Simon, of Manchester; the "Victoria," patented and made by Higginbottom & Co., of Liverpool; and the "Omega,"* a new machine, being introduced by Messrs. Turner, of Ipswich and London.

Let us take the "Koh-I-Noor" first (Fig. 7). The action of the machine is as follows:—The middlings are first spouted into a vibratory feed box, which delivers them in one thin even stream on to the sieve; they then travel along the sieve, being gradually sifted through, and the tailings pass down the tail spout. The middlings, as they pass along the sieve, are subjected to a continuous current of air which rushes up through the silk, carrying with it all the impure light particles; the dust-laden air then meets a deflector or cowl, which guides it down on to deposit platforms at the sides, the sides of the deflector being very close to the sieve, the air when passing under the deflector is greatly concentrated, and the strength of the current greatly increased, it is thus impossible that any of the lighter particles which have been lifted up can fall back on to the sieve. After passing under the deflector the air strikes the side platforms, the dust deposits by the expansion of the air, and is carried away by the vibratory motion of the sieve to the worm at the tail end. The air then slowly ascends to the valve above, the current gradually decreasing in strength, and thus allowing any light dust which may have been carried up to fall back. The air, on entering the valve, meets a supplementary

* *Note.*—This machine is now known as "Turner's Dustless."

deflector, which guides it down to the bottom of the second expansion chamber, thus causing a further precipitation of all light dust which may have floated up. The air then passes out through the fan mouth into the open room.

The "Reform" (Fig. 8). In this machine there is an arrangement of tin channels fitted immediately above the sieve; the air, laden with impurities, passes through a grid formed by these channels, expansion ensues immediately the air is through the grid, and the heavier dust settles in the channels, such as remains in suspension is carried up higher by the air, and some eight or nine inches above the level of the sieve is arrested by a flannel filter sheet; this sheet travels parallel to the sieve and covering all the space above it. The dust which adheres to the sheet is knocked off when the sheet arrives at the end of the sieve, and the portion of the sheet thus cleaned returns overhead to do its work again; the fan is fitted immediately over the lower portion of the sheet and exhausts into the open room.

The "Victoria" (Fig. 9). In this machine a metal tray fitted with nozzles is placed about three-fifths of an inch above the wire or perforated metal plate sieve, the two are vibrated together, the impurities are drawn through the nozzles, and when through, by the immediate expansion of the air, the heavier portion falls on to the tray, being thence vibrated on to a worm at the tail end, and the lighter pass into the upper expansion chamber, from whence they are wormed down to the tail end. The overtails are also treated by aspiration, forming virtually a gravity purifier. A slow-running fan, fixed at the top of the machine, running in the upper expansion chamber and exhausting into the open room, supplies the necessary air current.

The "Omega" (Fig. 10). The peculiar advantages claimed by Messrs. Turner for this machine are:—

1st. The trays over sieves are not connected to it, but are fixed, thus relieving the reciprocating parts of a great strain caused by the weight of trays. 2nd. They are at the same distance from the silk at all parts, not having need of any incline to make them deliver the offal into the troughs at the side of the sieve. 3rd. The offal is removed from trays by brushes; these brushes can be stopped, and the tins or trays allowed to fill; thus, the operative can see whether the air currents are equal across the sieve. In fact, this point enables him to test any deficiency in

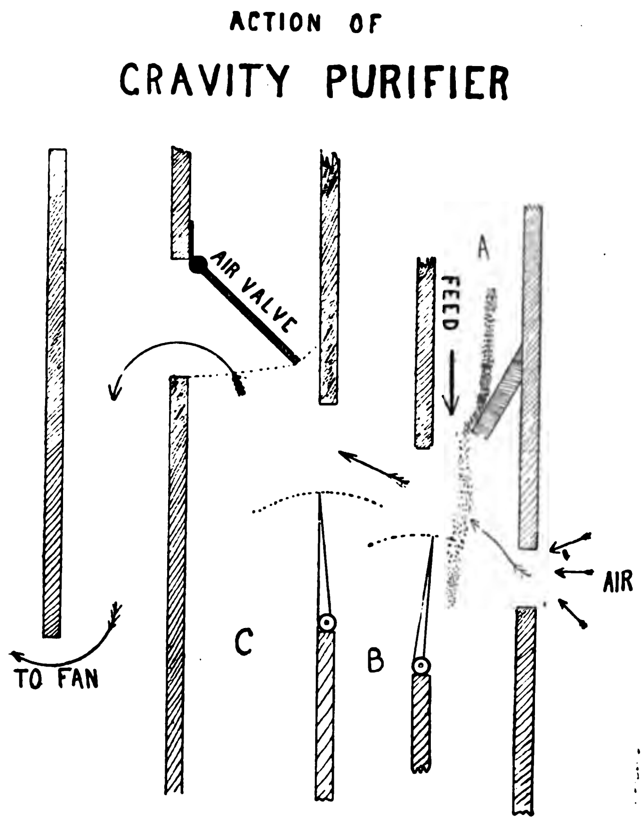


Fig. 6.

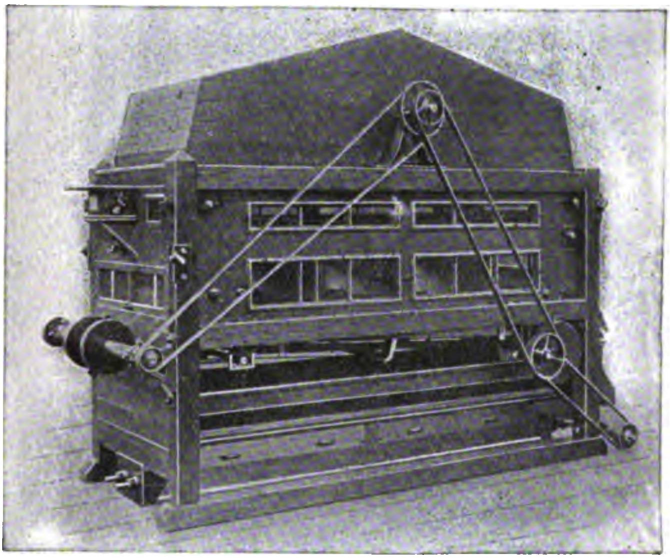


Fig. 7.

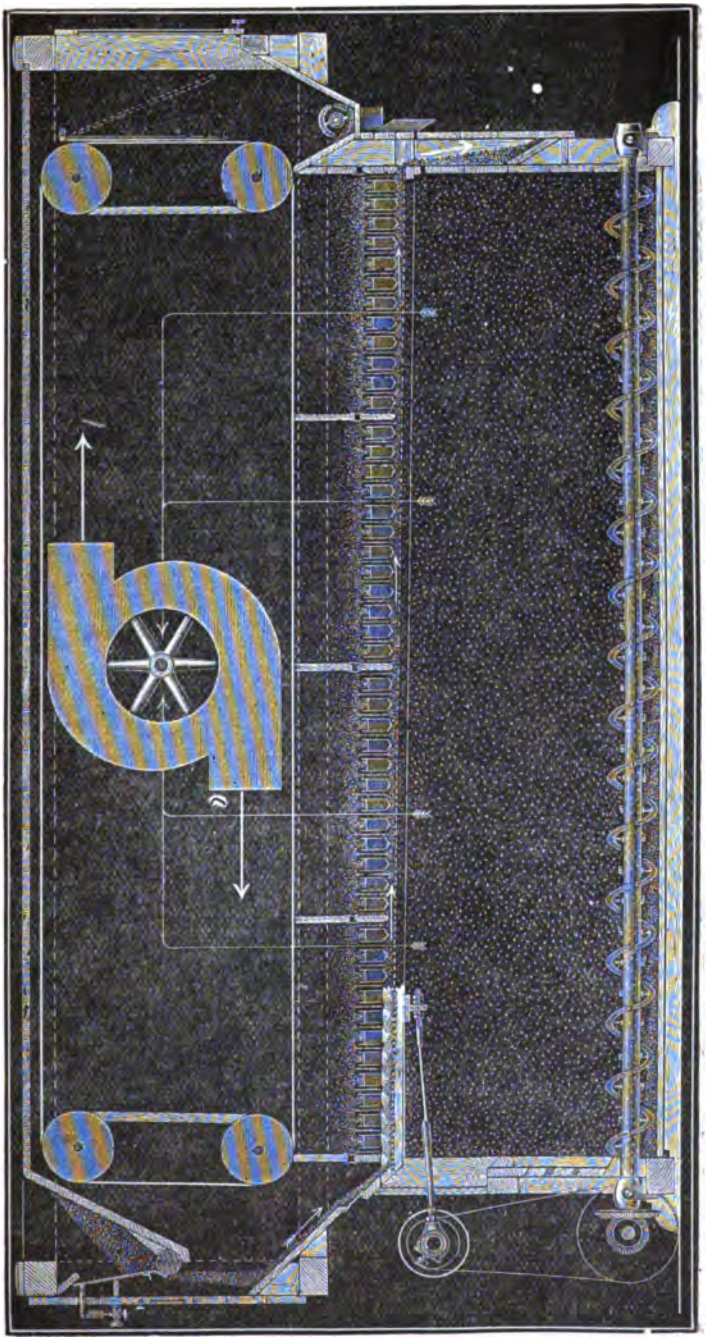


Fig. 8.

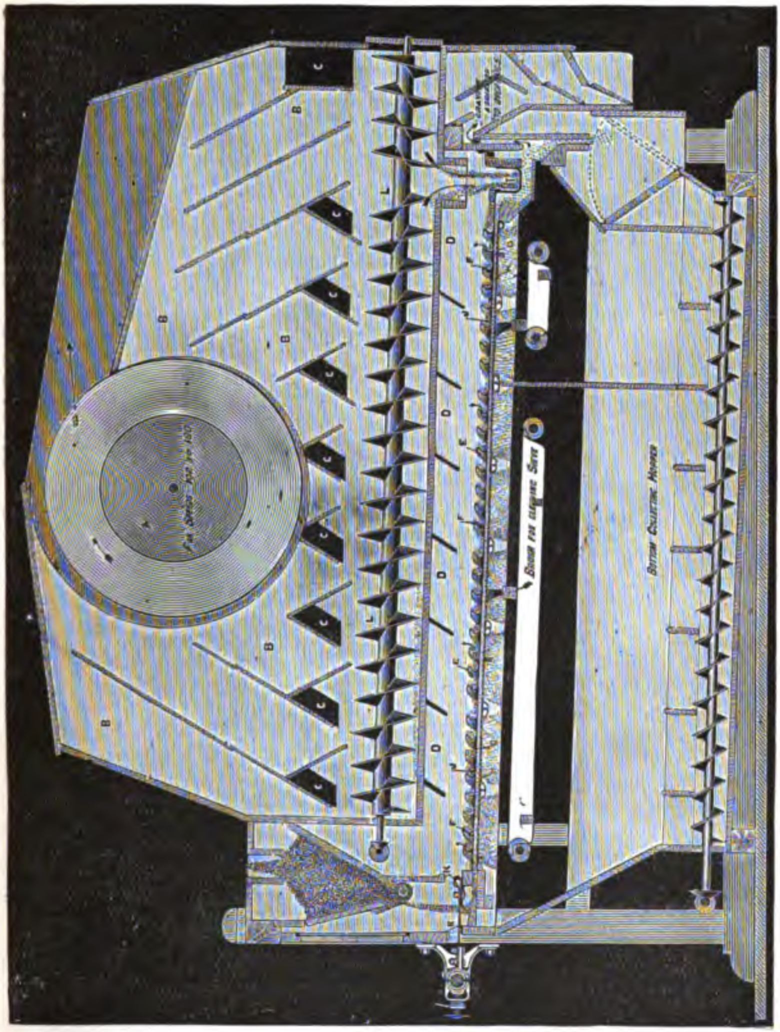


Fig. 9.

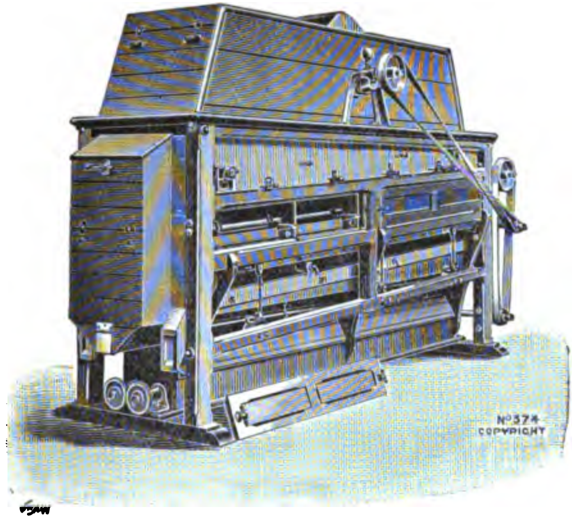
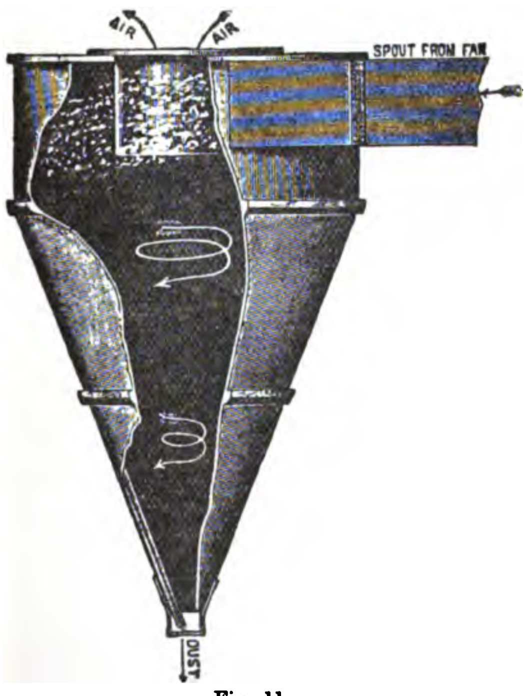


Fig. 10.



L Fig. 11.

the working, as, should the feed be heavier at one side, less air comes through the silk, and consequently less material would be lifted into troughs on that side. This, therefore, is a most important point. 4th. It will be noticed that the trays are rather further apart than in other machines. Messrs. Turner inform me that they made careful experiments on this point with fan running at same speed, air valves same opening, and same material being treated. The distance of 2 in. apart gave four times as much material lifted into trays as $\frac{3}{8}$ in. apart, and twice as much as 1 in. apart. 5th. By this arrangement the material travelling on silk is visible between the trays—a very great advantage. 6th. The machine is divided into four separate chambers, each with separate wind adjustment.

All these machines have, in common, two main principles—

1st. They have a slow running fan to create an exhaust only just sufficiently strong to lift the impurities from the middlings, the lighter being, of course, carried to a greater altitude than the heavier.

2nd. They claim to catch all the impurities they extract, and virtually succeed in doing so so long as the machines are running in a normal condition; should, however, the dust in the expansion chamber be stirred by any—we might say extraneous—current of air (such as the removal of one of the doors), a considerable quantity is carried out into the open room.

On the other hand, the older type of sieve purifier, such as the G. T. Smith, are just vibrating sieves fitted with a fast-running fan, exhausting air through the sieves into a stive room or dust collector; to properly free the middlings from impurities, the air current is necessarily much stronger at the sieve level than in the newer type, and good middlings as well as impurities are often lifted from the sieve and carried away.

The four machines I have described are, without doubt, from a miller's point of view, the best sieve purifiers on the market to-day, and *we* have reason to be satisfied also at the speed with which they are being adopted by the millers, inasmuch as the principles of their construction considerably reduce the fire hazard attaching to the process; a slow-running fan must be less risky than a fast one, particularly when, as in this case, all the dust exhausted from the machine passes through the fan chamber; moreover, any heat or spark developed in the machine is exhausted into the open room, and not through dust trunks into the stive.

On this very interesting subject of "dust" I shall have some remarks to offer later on.

The Reduction

of middlings and other products is performed by running them through rollers of similar construction to the break rollers, but having perfectly smooth surfaces. The number of rollers the stock passes through is here again a matter generally dependent upon the size of the mill; it is understood that the fewer the rollings the heavier the pressure must be on each, and below a certain limit it is admitted that the quality and colour of the flour deteriorate; after each rolling the stock is passed through a machine, which forms the fifth system to which I referred.

Flour Dressing.

Flour dressing machines are divided into two classes:—

1st. Simple reels, which are nothing more nor less than revolving silk-clothed cylinders enclosed in an outer frame; the stock from the reduction rollers is fed in at one end and is moved about by the revolutions of the reel, the flour passes through one portion of the silk and is conveyed away as finished; the middlings through another portion; the middlings and the tailings are taken to the next lower set of rollers, the process continuing, the resulting flour becoming poorer until nothing tails over but offals.

2nd. The centrifugal machine for the same purpose, this being a silk-clothed cylinder similar in construction to the last, but with the important addition of having within it a series of serrated beaters, which, revolving at a good speed, pick up the stuff as it passes through the reel, and toss it continuously against the silk.

We have now followed the flour to completion, and ready for the market.

Having noticed how many of the machines we have reviewed are designed primarily for the removal of dirt and dust, and having in mind the fact that by its very nature the bulk of this dust, when mixed in certain proportions with the atmosphere, is highly explosive, you will not be surprised to know that the question of its collection and disposal has for many years exercised the minds of milling engineers.

In the old days the dust from the stones was generally exhausted into a stive room, either, as was generally the case, in

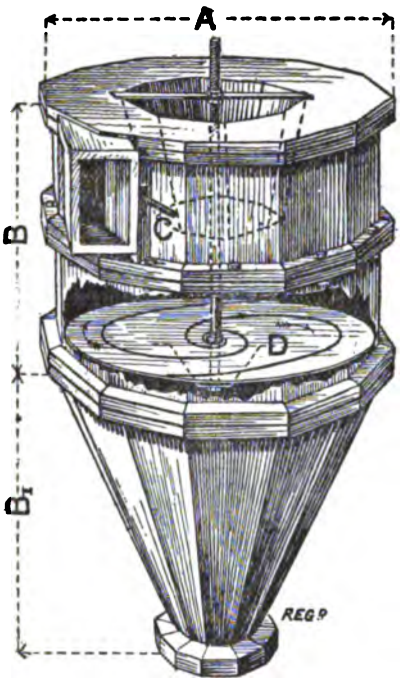


Fig. 12.

Fig. 13.

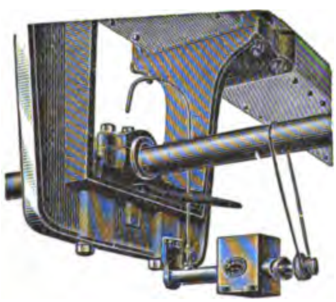


Fig. 14.

the mill itself or immediately outside it, and connected by wooden spouts, and in the earlier days of the rollers and purifiers the same course was adopted. The additional charges for the stive room inflicted by the Fire Offices Committee, with which all of you are well acquainted, had the effect of almost entirely removing this objectionable feature from the mill; but, as I think unfortunately, millers are allowed to have in the mill as much trunking as ever they please provided the vent is into an outside stive room, the result being that in many mills the trunking forms in itself a veritable stive, inasmuch as large quantities of dust are collected therein, and it is no uncommon thing to find some of the horizontal trunks connected with the cleaning plant fitted with rakes to enable the attendant the more effectually to clear the passage.

Dust in bulk is comparatively harmless, and one may put a light in contact with it without any harm happening, but put the same dust in motion by the operation of an air current, and immediately you have a mixture very highly explosive. I believe I am right in stating that scientists have not yet been able to say how *little* dust in a given quantity of air makes the mixture explosive, but they agree in considering as a fact that there is a point at which the air becomes, as it were, surcharged, and the mixture loses its explosive nature, but, be it noted, the mixture is still inflammable.*

Milling engineers consider, and I agree with them, that, it being necessary to put this dust in motion to clear it from the material being cleaned, the sooner you set it at rest again the better, and many ideas to this end have been patented; none, however, at the same time more simple and effective than the "Cyclone" (Fig. 11), patented by Mr. Hy. Simon, and the "Tornado" (Fig. 12), patented by Mr. Van Gelder. By the courtesy of the latter gentleman I am able to show you working models of both these machines.†

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* Before commencing to write these notes I had an idea of endeavouring to illustrate my remarks on the explosive nature of cellular tissue by some experiments, and had arranged the apparatus, but when I mentioned the matter to a friendly milling engineer he remarked, "Well, I don't think you will succeed, but you might, and if you do your friends will be sorry," adding, very pointedly, "you won't." I need hardly say I desisted.

† The lecturer here showed the models in operation, and it was seen how efficiently the system worked even in a model.

Having now noted how quickly and effectually the dust has been set at rest and collected in bulk for removal, I ask if you do not think the use of such a machine fixed close up to, say, each machine, or group of machines, preferable to the long trunk through which the dust-laden air has ordinarily to travel under compression.

I believe these machines were first designed for use with purifiers, but, as we have seen, heavy and light dust are alike collected by them, the air issuing therefrom almost quite free from dust. Care has to be exercised in arranging the size of the machine to the work it has to do, as, if overloaded, there is both a back pressure on the fan and an escape of dust into the room, but this is of course a detail capable of arrangement, and does not affect the principle; personally, I feel inclined to ask the milling engineers why the scientific truths respecting the compression and expansion of air, so beautifully utilised in the middlings purifier, cannot be made use of also in dealing with the wheat; it seems to me to be quite within the range of practical mechanics to construct a purifier on the principle of the "Omega" or "Victoria," modified, of course, in detail, quite capable of dealing with the rubbish loosened by the scourer and brushing machine. I need hardly say this is a consummation devoutly to be wished.

Although "Corn Milling Machinery" is the title of my paper, I hope, Sir, you will not rule me out of order if I venture a few remarks on some of the more frequent causes of fires in Corn Mills, and mention one or two points to which, I think, Fire Insurance Surveyors should give special attention.

In this connection, the bearings of the machines call for first mention; they should, in all cases, be so arranged as not to be in the path of the air outlet, and, in the case of the fans, they should be also clear of the air inlet. This is a most important point, as by its neglect sparks may be carried into the dust trunks, and explosions result.

All machines should be open to access on all sides, as careful and constant lubrication is practically impossible in a very crowded mill; the importance of this point cannot be over-estimated, for it is admitted that heated bearings are, without doubt, the most fruitful cause of corn mill fires.

A simple but ingenious device of considerable utility for the constant lubrication of shafts has lately been patented by Mr. Hy. Breton, of Leeds, and only requires to be better known

to be more widely used (Figs. 13 & 14); briefly, it consists of a screwed spindle working horizontally in a cylinder fed with oil from a small cistern over, the screw is driven from the shaft which is being lubricated, and the oil is pumped by the worm action up a suitable feed pipe into the oil aperture of the bearing, it is caught by a metal receiver fitted around the bearing, and conveyed back to the cistern, passing through a wire gauze filter box before passing on to the screw again, the oil is thus worked over and over again, lubrication is constant so long as the shaft revolves, and there is no waste.

Elevators, especially those for conveying flour, require close attention; they should each be driven separately, and be freely provided with openings by which any choking may be cleared; the strut board at the top of the elevator trunk, as generally constructed, horizontally to the up and down trunk, gives material a splendid lodgment, and a choke often occurs at this spot if the greatest regularity is not observed in its clearance; Surveyors should, then, make diligent enquiry on this point, as the job of clearing is not a nice one, and may be shirked if the men are not well looked after. I would, however, recommend millers and milling engineers to set these strut boards diagonally at an acute angle, the lower ends to be towards the "up" trunk; any overflow from the cups would then slide down the trunk again, or better still, the board might vent through a short spout on to the line of the upcoming cups.

Millers will tell you that naked gas lights so fixed as to swing against wood partitions and the woodwork of the machines in close proximity to the floor above and to openings in spouts and elevators, and open hand lamps for looking into wheat bins, and such like hazardous conveniences, are absolutely necessary to the proper conduct of their business; my advice is, simply, don't believe a word of it; some mills are worked without a naked gas light in the place, and some are successfully worked under *enforced* rules which provide for the instant dismissal of any man using an unenclosed hand lamp.

Several fires have been traced to a defective floor allowing dust, &c., to trickle through on to a naked gas jet, and from a full account given in the current month's issue of *The Miller* of the fire at Seth Taylor's mill at Dockhead, on Jany. 13th, it would appear that the mill was burned down through a similar cause. It would appear that a choke occurred on the ground

floor in an elevator trunk passing through an upper floor, a door of this trunk was suddenly burst open by a large lump of material, which, scattered into the room, was ignited by a gas jet, with the result that a long tongue of flame started upwards and burned through a wooden trunk, at one end of which a fan was simultaneously exhausting from the mill and blowing through an opening in the wall into the adjoining stive room. The flame seems to have been carried into the stive room, and there an explosion took place. Meantime the flame had been returned through the trunk to the room in which the fire began, and the operatives, instead of trying to put out the fire with the buckets of water at hand, started off to seek help.

The introduction of the electric light is, I think, a step in the right direction, but it should be accompanied by some arrangement for hand lamps; on this subject Mr. Hy. Simon says:—"In addition to the ordinary electric lights, I have had a number of junctions or connecting joints fitted in the neighbourhood of all places where additional lights may occasionally be required to examine the material, or to set the machines when they would be at work, or for any other purpose of examination or inspection. A portable electric lamp, with 10 or 12 feet of insulated wire, is then left on each floor under the charge of the attendant, and by attaching the end of the wire to different junctions he gets a brilliant light in any particular part of the mill where he may require it. As a further development of this idea, I have sometimes fitted up in gas-lighted mills a small dynamo only capable of supplying two lamps of high candle-power each, and by placing this small dynamo on a floor, and driving it from the ordinary shafting, the attendant is supplied with a safe portable light in the manner named above. The success of this application justifies me in recommending its general introduction in mills which cannot have a complete system of electric lighting."

In corn mills, as in every other class of risk, cleanliness is an all-important point; a dirty mill is not only dangerous on account of the accumulation of dust and dirt, but is a sure indication of bad management in other directions; insufficient lubrication probably accompanies it. Moreover, a carelessly kept mill is generally an unprofitable one to the owner.

In conclusion, let us contrast the almost universal system of making flour by the employment of the grader, screen or brushing machine, mill stones, and one or two flour dressing machines in

vogue only about 15 years ago, with the system at once so elaborate yet perfect in detail, and so almost automatic, that throughout its whole course the material has not to be handled save, say, once a day, when samples are taken from each machine for examination by the person in authority; truly, the change is marvellous, and I don't know a more fitting illustration of the necessity—and I use the word advisedly—of Insurance men keeping absolutely in touch with the latest development in science, mechanics, and chemistry, particularly if it is agreed that the employment by Insurance Companies of experts in the various branches of trade and manufacture should be an exception rather than the rule.

JAMES WARDLE,
Liverpool and London and Globe Insurance Company, Leeds.

Insurance Institute of Yorkshire,
26th February, 1892.

[The lecture was illustrated by a very large number of beautifully executed drawings of the various machines referred to, and the lecturer's references to the details of the mechanical movements were closely followed by the members present. Samples of wheat in the various stages, and of the impurities extracted by each machine, were also shown, and at the close of the lecture Mr. Wardle asked the members to join with him in thanking the various people who had so courteously lent them for the purpose, particularly mentioning the Council of the Society of Mechanical Engineers, by whose permission there was shown a full set of drawings of a roller mill at Rio Janeiro, which had been made by Mr. Hy. Simon, to illustrate a lecture read by him before the members of that society. In acknowledging the vote of thanks Mr. Wardle also mentioned the great assistance he had derived from a perusal of Mr. R. Voller's book on Modern Flour Milling.]

ROLLER MILLING.

In dealing with this subject, which is no doubt more or less familiar to all the members of the Society, I purpose, before entering upon a general description of the process, to preface my remarks with some observations as to the construction of the buildings, followed by a description of some of the more important machines in this class of risk. By doing so, it will admit of the process being described in a more continuous form, without any lengthy reference or explanation of any particular machine, and at the same time I trust this course will render the subject none the less interesting.

To the passing observer, the flour mill of the present day remains unchanged, for there is nothing to indicate, so far as the structure is concerned, that a complete revolution has taken place in the internal arrangements.

Buildings.

The mills, however, which have been recently erected present some new features in construction, and have been specially designed to meet the requirements of the roller system of milling.

In the old mills, the floors were formed in the usual way of joisting and flooring, while the walls were usually built of stone and plastered. In recent mills, however, the walls are generally of brick, which is preferable to stone, while some deviation has been made in the construction of the floors. For instance, in the Ibrox Mills, which were built a few years ago, the walls are of brick, but the floors are formed of planks, which admit of more space between the joists.

Since then some mills have been built fireproof, and we have an instance of this in the Regent Mills, which were completed recently, the floors of which, in one department, are formed of planks crosslaid with ordinary flooring, while the floors of the stores are fireproof, being formed of malleable-iron joists embedded in concrete.

Of the non-fireproof floors, those formed of planks and flooring, already referred to, are no doubt the best of this class, and should be adopted more frequently for mills and workshops in general. Floors of this kind admit of the joists being set wider apart, which interferes less with elevators, which are so numerous, and another advantage is that such floors would resist fire much longer than ordinary floors.

The fireproof floors previously referred to seem to me best suited for stores and such like where the stock, as in the case of flour and grain, is not combustible, but in all fireproof floors some provision should be made for the outlet of water at the level of each flat, for it has been found where fires have occurred in such risks that the water damage has been much more serious than the fire damage, owing to the accumulation of water on the floors. In the case of mills where explosions may happen, it would be desirable to make some provision for the force of the explosion where iron roofs are adopted, for in an explosion which happened lately in the ground flat of a fireproof mill it was found that the main damage to the building was in the attic flat, where the upper parts of the walls were shattered, in consequence of the roof being lifted bodily from its position, while the intervening floors suffered little or no damage. Another point which is usually overlooked in fireproof buildings is this, that where two such buildings communicate internally by doors, the doorstep or ingoing of the door is generally on the same level with the floors on both sides of the opening, the result being that, when a fire happens in one building, the water flows through the doorway and extends the area of the damage, and this could be avoided, very simply, by having the doorstep a few inches above the highest floor level.

As far as possible, the stairs should be placed outside the building and made fireproof, with iron doors on each landing, and the stair walls carried above the level of the main roof for the accommodation of water tanks to supply the sprinklers. Where the roofs are not fireproof, the sprinklers are usually placed above the ceiling of the attic flat about half-way up the roof, and this arrangement, I may mention, was found satisfactory in a fire which happened recently in a mill where the sprinklers were placed in the position referred to.

Although there is, strictly speaking, no such thing as a construction that is absolutely fireproof, it being only a question

of the duration and intensity of the heat evolved in the case of a fire to determine the duration of a structure, yet it has been proved to be possible, by means of special modes of construction, to so limit, in the event of a fire breaking out, its destructive influence that the term "fireproof construction" may almost be said to be true.

While all systems of fireproof construction use, almost necessarily, iron to form, as it were, the skeleton, the older systems relied exclusively on cement concrete for filling in.

The more recent systems, however, discard this material, and rely upon substances that have already been through the fire, such as pottery, tiles, and specially-shaped bricks, &c. From the well-known inability of Portland cement to withstand heat this departure would appear to be a step in the right direction.

Where gas is employed for lighting, the gas pipes and fittings should be of iron, while the brackets should be fixed, not jointed, and placed against the wall, free from all woodwork. The gas jets should not be enclosed with glass globes, but left open, and the timbers of the floors over the jets should, where necessary, be protected by a metal plate.

The use of open oil lamps for portable light should be discouraged, if not entirely prohibited, as they are liable to be upset; and enclosed lanterns should be provided where hand lamps are required.

Electric lighting should be encouraged, however, as it is particularly well adapted for roller mills, as the portable oil lamps could then be replaced by portable electric lamps, which would very materially lessen the risk of fire. In this connection, I may remark that the Regent Mills are lit by electricity throughout, and have portable electric lamps on the various floors.

Electric lighting has fewer fields of usefulness than in flour mills, and now that it has passed the experimental stage, its adoption is becoming rapid.

In the roller mill there is every element for economical production and maintenance, and while its brilliancy, clearness, and coolness need no comment, it cannot be too strongly impressed that, in a properly installed system of lighting by the incandescent or glow lamp, we have the safest illuminant in existence. There are two methods of producing this light—the arc and incandescent. The arc lamp consists of a framework carrying two rods of carbon, the ends of which are presented to each other at a slight distance

apart, and the "current" being sent through one of these, is conveyed across to the other by means of an atmosphere of minute particles of carbon, which it detaches from the rod and renders luminous; the current, in passing across, forms an arc—hence the name.

The incandescent lamp consists of a glass bulb (hermetically sealed after being exhausted of air) containing a thread or filament of carbon in the form of a loop, the ends of which are connected to two platinum wires that pass through and are sealed into the neck of the bulb, whereby the current is conveyed to and from the filament. The filament being of high resistance and of small section compared with the conducting wires, the energy of the current passing through the small conductor causes it to become hot, and if the intensity of the current is increased sufficiently, it brings the filament into a state of white heat or incandescence, and hence its name. The arc lamp giving off unpleasant fumes, and dispersing a considerable quantity of carbon into the air, is only used out of doors or in large open buildings, such as railway stations. The incandescent lamp, giving off neither fumes nor carbon, is used indoors, and as it cannot ignite any gas or explosive substance, being sealed up in a glass bulb, it may be used with perfect safety in mills where any other kind of light would be unsafe, if not positively dangerous.

Wheat-Cleaning Machinery.

The cleaning is usually done by separating, smutting, and brushing, also the extraction of cockle seeds, oats, and barley, and, in the case of Indian and Egyptian wheats, by washing, stoning, and drying. The wheat, however, which comes to this market does not require washing, but diagram No. 1. represents a wheat washing and drying plant which shows how this operation is carried out, and diagram No. 2 shows a wheat-receiving separator.

After the wheat has passed through an automatic weighing machine, it passes through reels which are provided with covers composed of steel wires.

The reels sort the wheat into sizes, which are treated separately throughout the remainder of the cleaning process, and the treatment is the same for each size, but the sorting into sizes ensures better results. The next machines in the process are cockle cylinders. Their covers are composed of zinc, and have their

WALWORTH'S PATENT FOUNTAIN GRAIN WASHING STONING AND PURE HOT AIR DRYING PLANT.

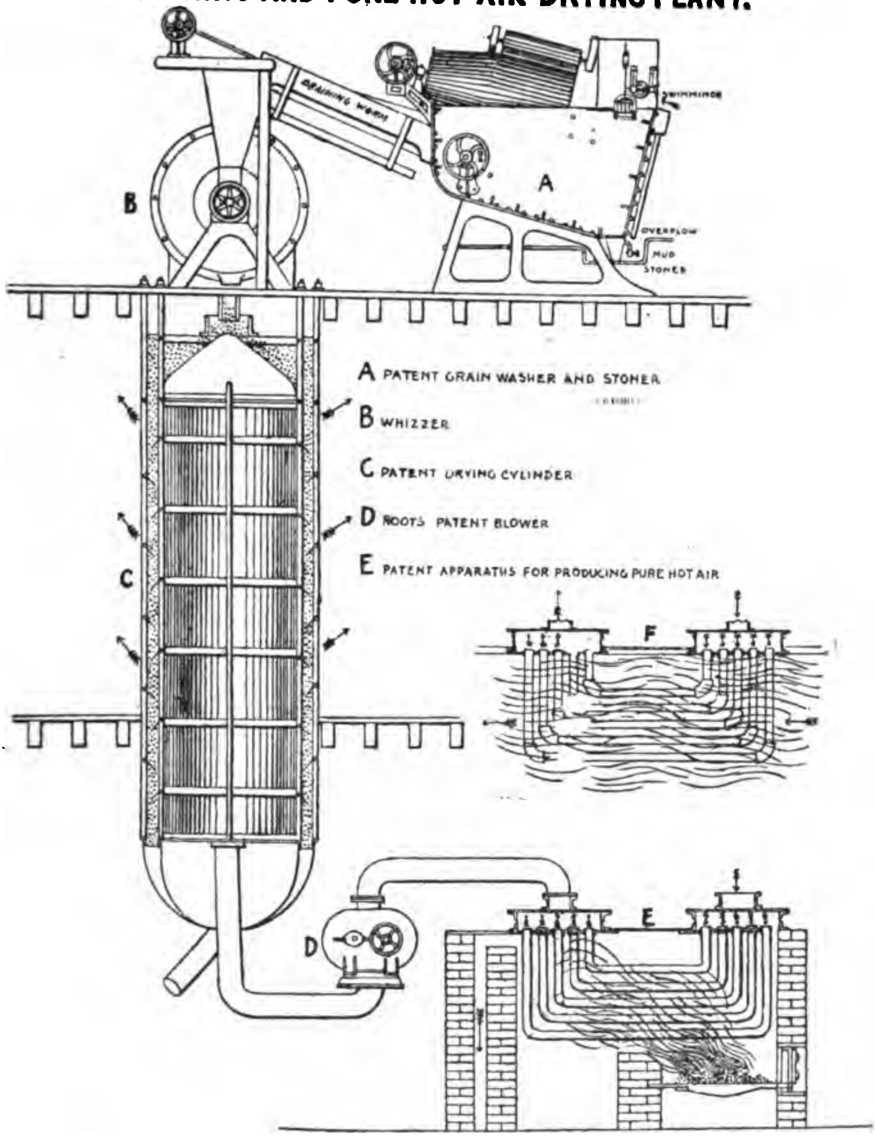


Diagram 1.

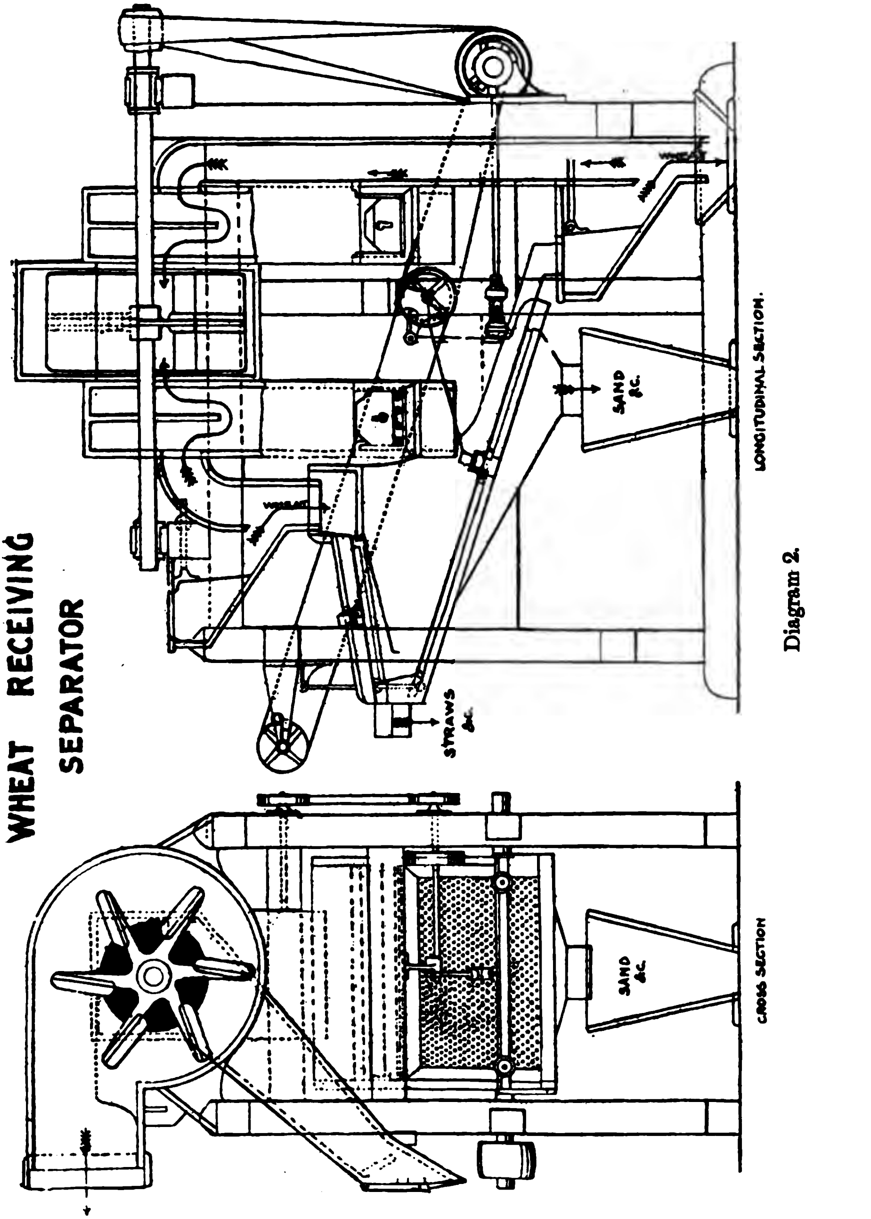

WHEAT RECEIVING SEPARATOR
WHEAT
SAND &c.
STRAWS &c.
LONGITUDINAL SECTION.
SAND &c.
CROSS SECTION

Diagram 2.

interior surface impressed with indentations of such size and form that in the cockle machines all seeds, &c., smaller than the wheat are lifted out, while in the barley machines the wheat is separated from all grain longer than itself. From these reels or cylinders it passes through machines called "scourers" or "smutters," which consist of a hollow drum on which are adjustable friction blades. This drum is enclosed by a case or cylinder of chilled iron, which is perforated, making it thoroughly ventilated.

The grain, as it passes through the scourer, is whirled by the friction blades against the perforated sides of the cylinder, and the general effect of the combined action of the blades and perforated walls of the cylinder, along with the action of an exhaust fan, is to scour such impurities from the wheat as may be adhering to its husk or lodged in its crease. The grain, as it leaves the scourer, passes over a set of magnets which extract any pieces of metal from the wheat, such as may have been in the grain itself, or which may have come from the machines in the process of cleaning.

The scouring is followed by a brushing process, and we have an example in diagram No. 3 of the Victor double brush machine.

The sectional view shows that the brushing is done by a series of concave circular brushes attached to an upright shaft, while a corresponding series of convex brushes are built up in the machines and remain fixed at all times. The surfaces of the two brushes are made to fit each other, so that when the lower brush is set up close to the upper it forms a solid mass. The wheat is spouted, as may be seen, into the machine upon the top surface of the upper fixed brush, where it gravitates to the centre and is caught by the revolving brush, which, by its centrifugal force, forces it outward between the brushes to the edge, where it drops to the upper surface of the next fixed brush, and again gravitates to the centre, is again caught by a revolving brush and forced upward and outward as before.

It will be seen that the revolving brushes all incline upward from the centre, so that the wheat is obliged to climb uphill, thus retarding its flow outward, and thereby more effectually brushing it.

The brush machine has a speed varying from 450 to 500 revolutions per minute.

There are other kinds of vertical brush machines, consisting of single circular brushes revolving inside a perforated iron case, with exhaust appliance similar to the one already described.

In diagram No. 4 we have an example of a horizontal brush machine which is employed for the same purpose as the other machines referred to.

Roller Mills.

As the roller machine is the leading feature and novelty in the new system of grinding, it calls for special notice. The rolls by which the wheat berry is reduced are called "break rolls," and have generally two, three, or four rollers placed horizontally. In the two- and four-roller mills the pairs are grooved with saw-shaped or rounded flutes. The first break rolls have saw-shaped flutes, and grooved 8 to 12 flutes to the inch, straight and parallel with the axis of the roll, the backs of the teeth doing the work with a squeezing action.

The sizes are various, but usually from 9 or 10 inches diameter to 18 and 20 inches in length, with a speed of 100 and 200 revolutions per minute, giving a differential speed of 2 to 1. Diagram 6 represents a pair of first break rolls with the flutes exaggerated in size, showing the direction of motion and the flutes working back to back, the grooves in the fast roll overtaking those in the slow roll.

The second, third, and fourth break rolls are grooved from 16 to 28 flutes to the inch, and cut spirally at an angle of 15 degrees with the axis of the roll. The sharp edges of the flutes revolve against each other with a scissor-like action, the spiral preventing any likelihood of their interlocking; but all roller machines have fixed stops to prevent the rolls touching. Diagram 6A represents the fluting and direction of motion of these rolls, the sharp edges on the fast roll overtaking the sharp edges on the slow roll, cutting the grain falling between. Diagram 7 is a plan of a pair of rolls showing the angle of the flutes, and the dotted lines show the position of the angles at the bottom or other sides of the roll.

All iron rolls are made of chilled cast-iron, which is a kind of cast-iron with a chilled surface of glass-like hardness produced by being cast in a mould of well-conducting material, such as iron, steel, or brass. The thickness of the chill in rollers is generally sufficient to stand refluting 15 to 20 times, and each time a roll requires to be refluted the old flutes have to be ground out, and the grooves are then re-cut by a specially-designed lathe or planing machine for the purpose.

VICTOR DOUBLE BRUSH SCOURER.

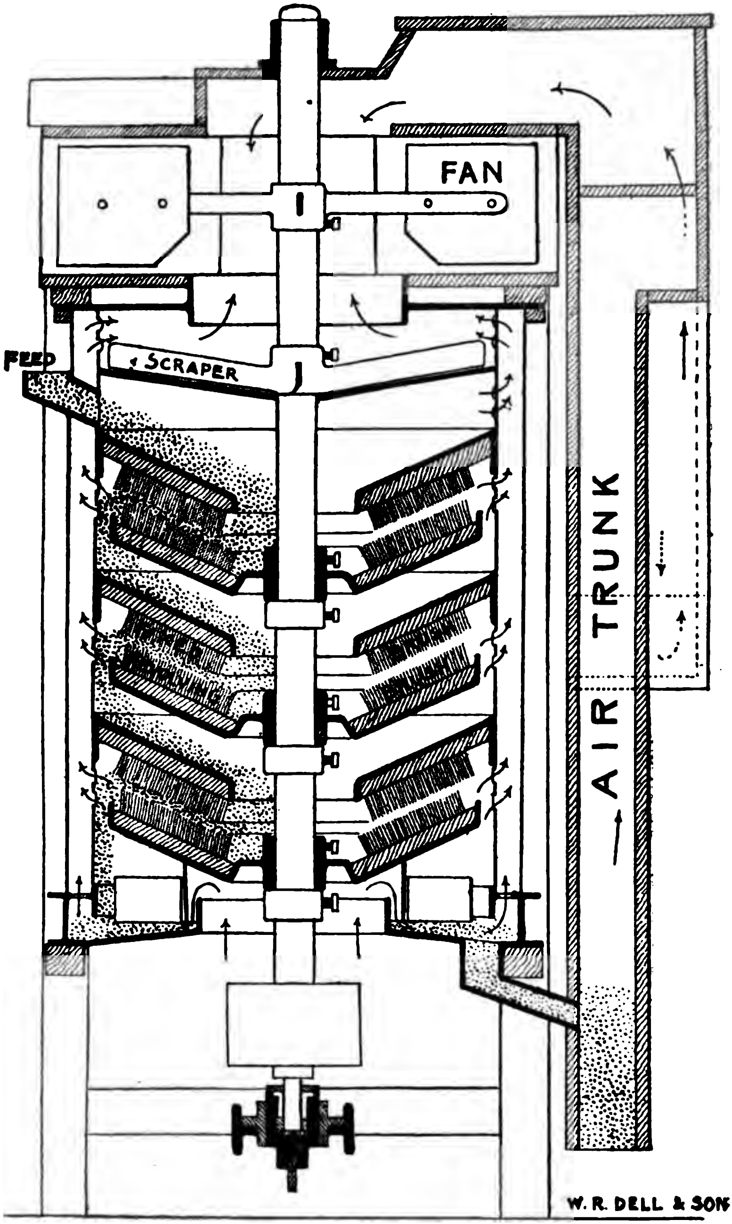


Diagram 3.

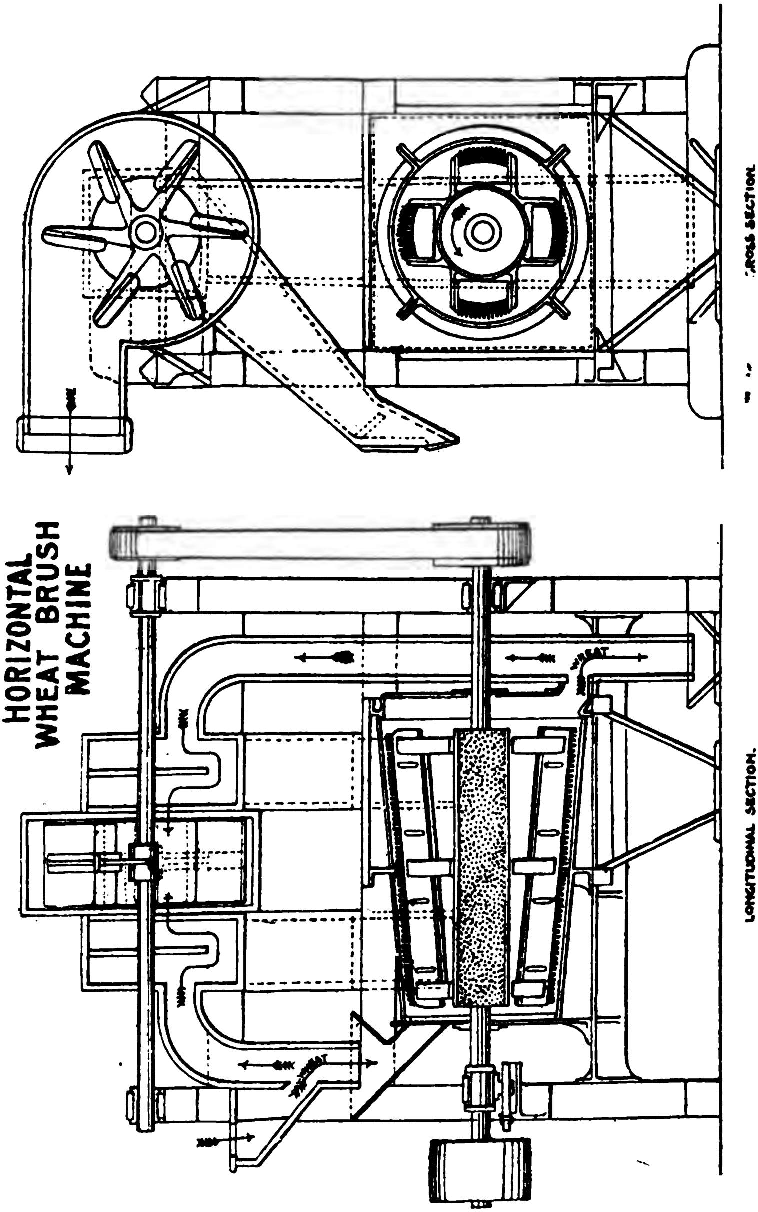
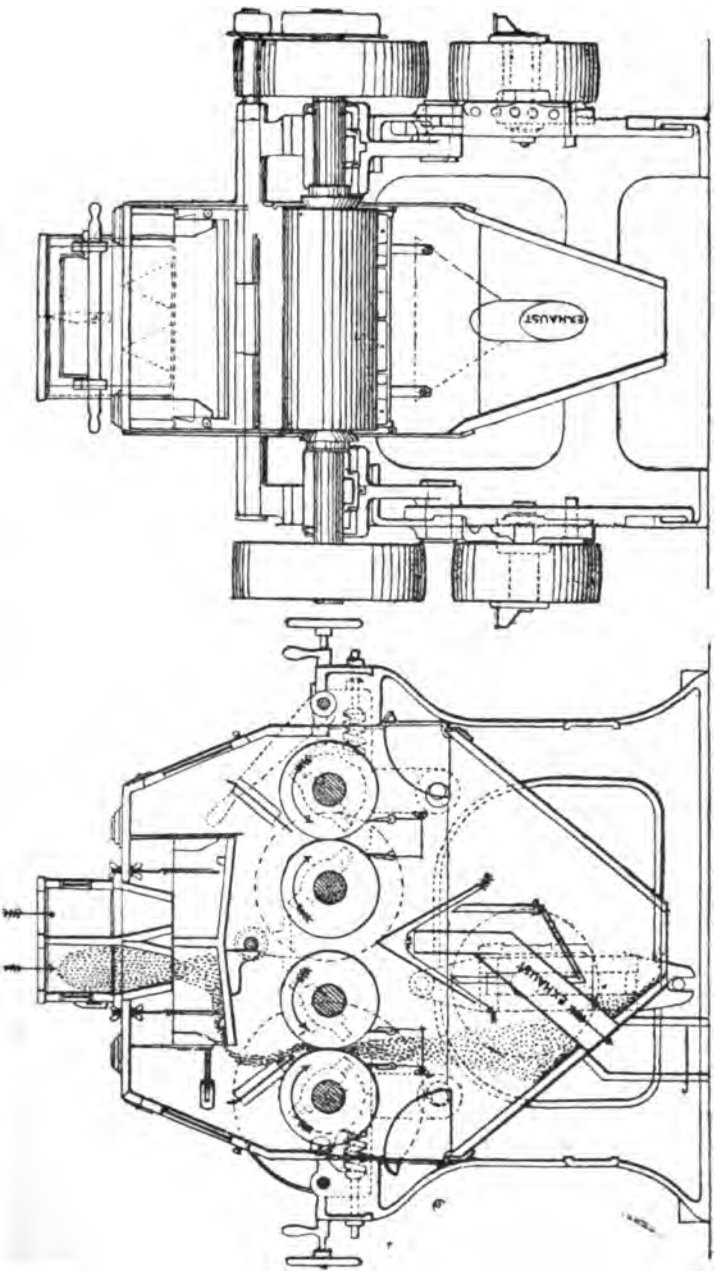

HORIZONTAL WHEAT BRUSH MACHINE
CROSS SECTION.
LONGITUDINAL SECTION.
WHEAT

Diagram 4.

HORIZONTAL ROLLER MILL



CROSS SECTION

LONGITUDINAL SECTION

Diagram 5.

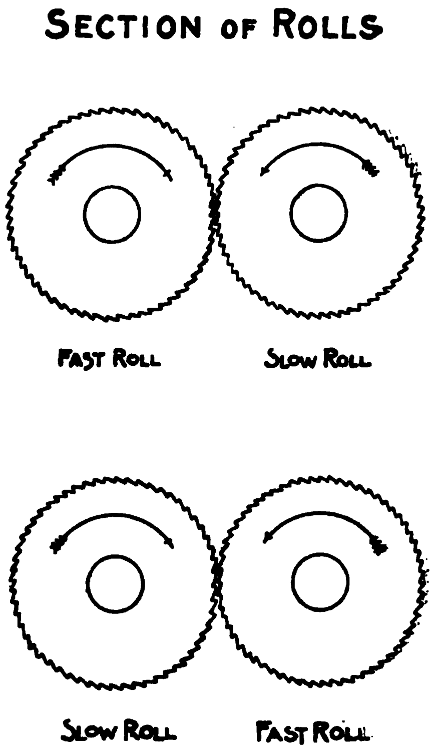


Diagram 6.

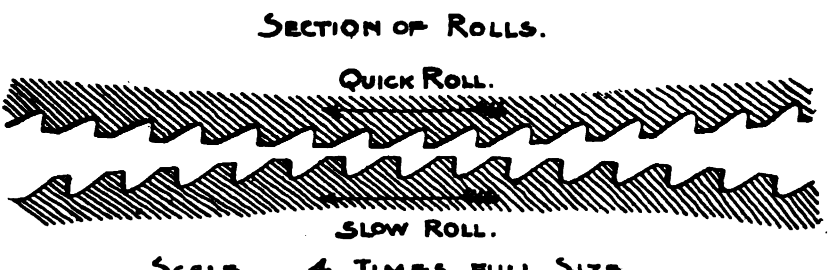


Diagram 6A.

PLAN OF ROLLS

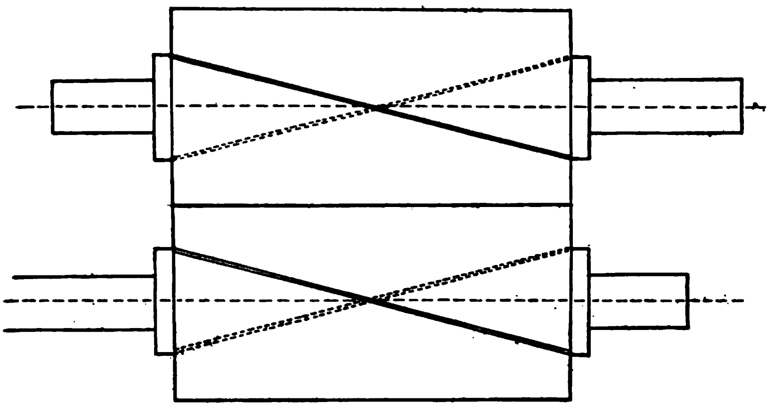


Diagram 7.

The reason why corrugations and differential speeds are used for break rolls is, that if grain is passed between two smooth rolls made of any substance it will be crushed, but the particles of the crushed mass will not fall apart. To accomplish the latter it is necessary that one of the rolls should run ahead of the other —that is, it must revolve at a greater speed.

The fluted break rolls are placed slightly apart, varying from $\frac{1}{16}$th of an inch to $\frac{1}{96}$th of an inch, but the actual adjustment varies with the class of grain.

Smooth iron rolls are also geared with a differential speed in the proportion of 170 to 200 revolutions per minute, while porcelain rolls—which are simply iron rolls with a shell of porcelain—have usually a speed of 120 to 130 revolutions per minute, and all roller machines are fitted with an automatic feed which provides both for an excess of feed and for a deficiency of supply.

There is no doubt that the roller machine in itself is much less dangerous than the old system of stone grinding.

Centrifugal.

The centrifugal is simply a silk dressing machine, of which we have an example in diagram No. 8. The reel encloses a revolving shaft with beaters running at a higher speed than the reel, which drive the material against the clothing of the reel. There are various arrangements of machines, but all more or less on the same principle.

A centrifugal has the same action as a fan—driving air from the central openings and discharging it through the clothing at its circumference, but this action has to be controlled or limited as much as possible. Transverse divisions are frequently added underneath the cylinder, so as to separate two or more sizes of flour and middlings along the length of the machine.

Purifiers.

There are several kinds of purifiers, which may be divided into two classes, and we have examples here in diagrams Nos. 9 to 12 of three machines, all of which are dustless purifiers—that is to say, a purifier which discharges pure air into the mill and requires no dust room or dust collector. The other class of machine emits dust or impure air, which is conveyed by spout or trunk to a dust collector or stive room.

N

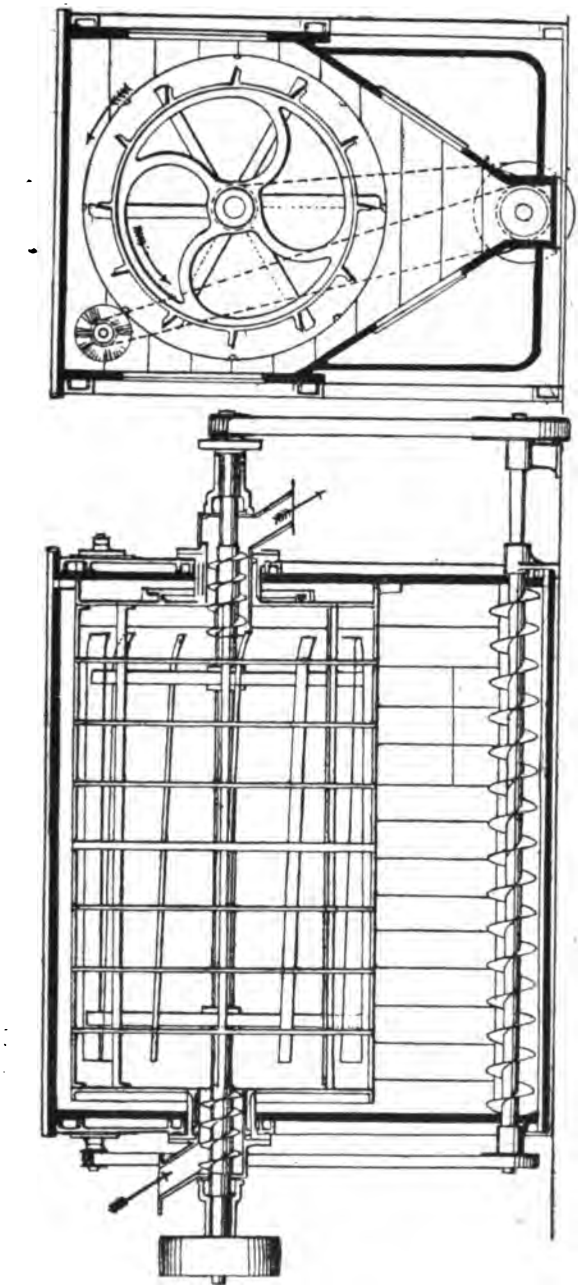
The leading feature in the Victoria purifier, as shown in diagram No. 12, consists in the use of a vibrating tray of nozzles covering the whole area of the sieve. The construction of the tray is as follows:—A flat tray of zinc is fixed above the sieve surface, and a large number of small holes are made in the tray close to each other. Each of these holes is fitted with a nozzle on the top side of the tray. The nozzles are hollow, and they are wider at their bases than at the top, for the purpose of causing the air rising through the interior of the nozzles to become accelerated in its velocity on all sides. Each nozzle has a small discharge orifice, and the centre of the orifice is placed at a short distance from the sieve surface. The air discharged from each orifice is expanded the moment it leaves the orifice, and thereby the impurities carried up through the nozzles are deposited on the upper surfaces of the nozzles and the tray, from whence they are removed automatically by the vibratory motion of the tray. The impurities are deposited in the interior of the purifier itself, and the air is discharged by the exhaust fan into the room where the purifier is at work. Each purifier is fitted with one slow-moving exhaust fan, so that fast-running fans and their concomitant risk of fire are entirely dispensed with.

The Kohinoor purifier, of which we have an example in plans Nos. 13 and 14, is also of novel construction, very different in appearance from any other machine. It consists of a tapered sieve, becoming narrower at the tail end. Like the "Victoria," its fan blows direct into the mill, and yet without blowing dust into it, the light matter remaining in the machine.

The claim for the tapered sieve is that, as the middlings or semolina decrease in quantity outward towards the tail, the narrowing of the silk insures a continuation of the same thickness of feed as at the head of the machine, thus securing the opportunity for the gravitation towards the silk of the heavier particles, the lighter floating on the top. As the sieve narrows, the platforms, as they are called, on each side widen, leaving ample room for the settlement of the material drawn off the sieve.

The advantages of being able to dispense with stive rooms, dust collectors, and air trunks will be apparent, as these qualifications enable such machines to be placed anywhere.

CENTRIFUGAL DRESSING MACHINE



CROSS SECTION.

LONGITUDINAL SECTION

Diagram 8.

TURNERS DUSTLESS PURIFIER

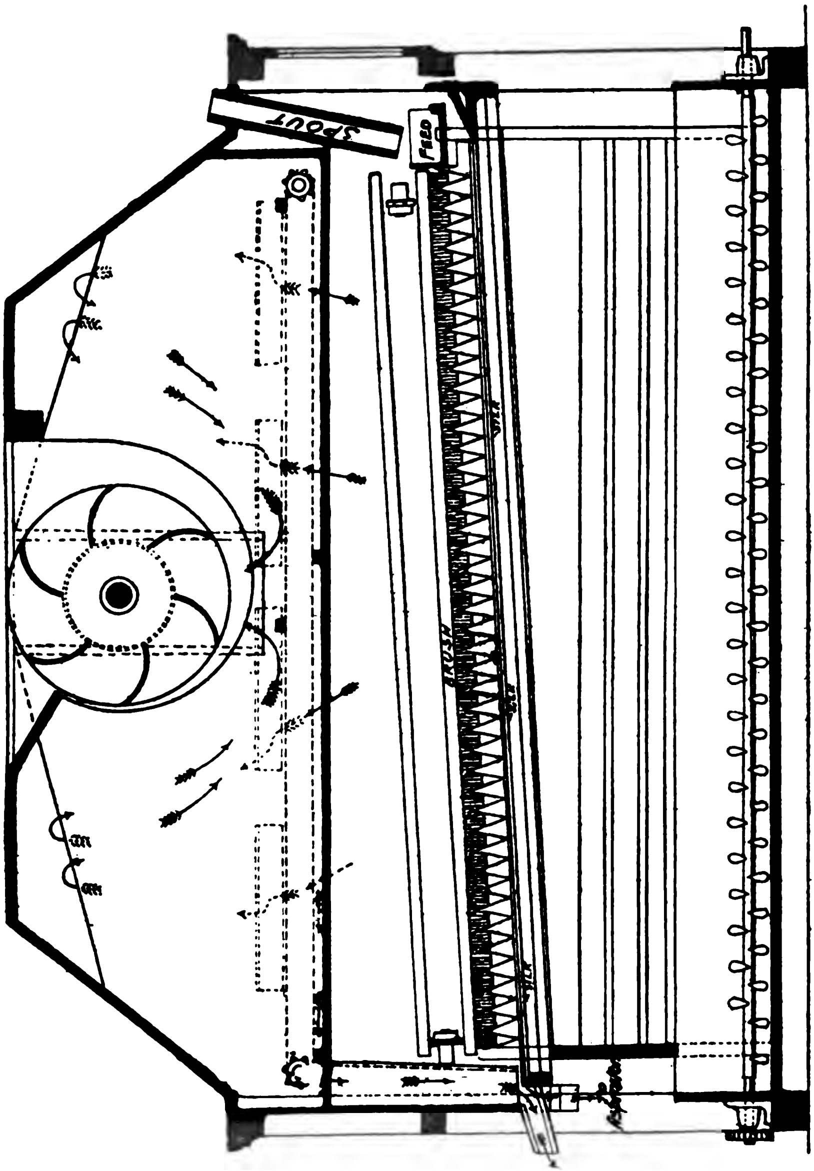


Diagram 9.

TURNERS' DUSTLESS PURIFIER.

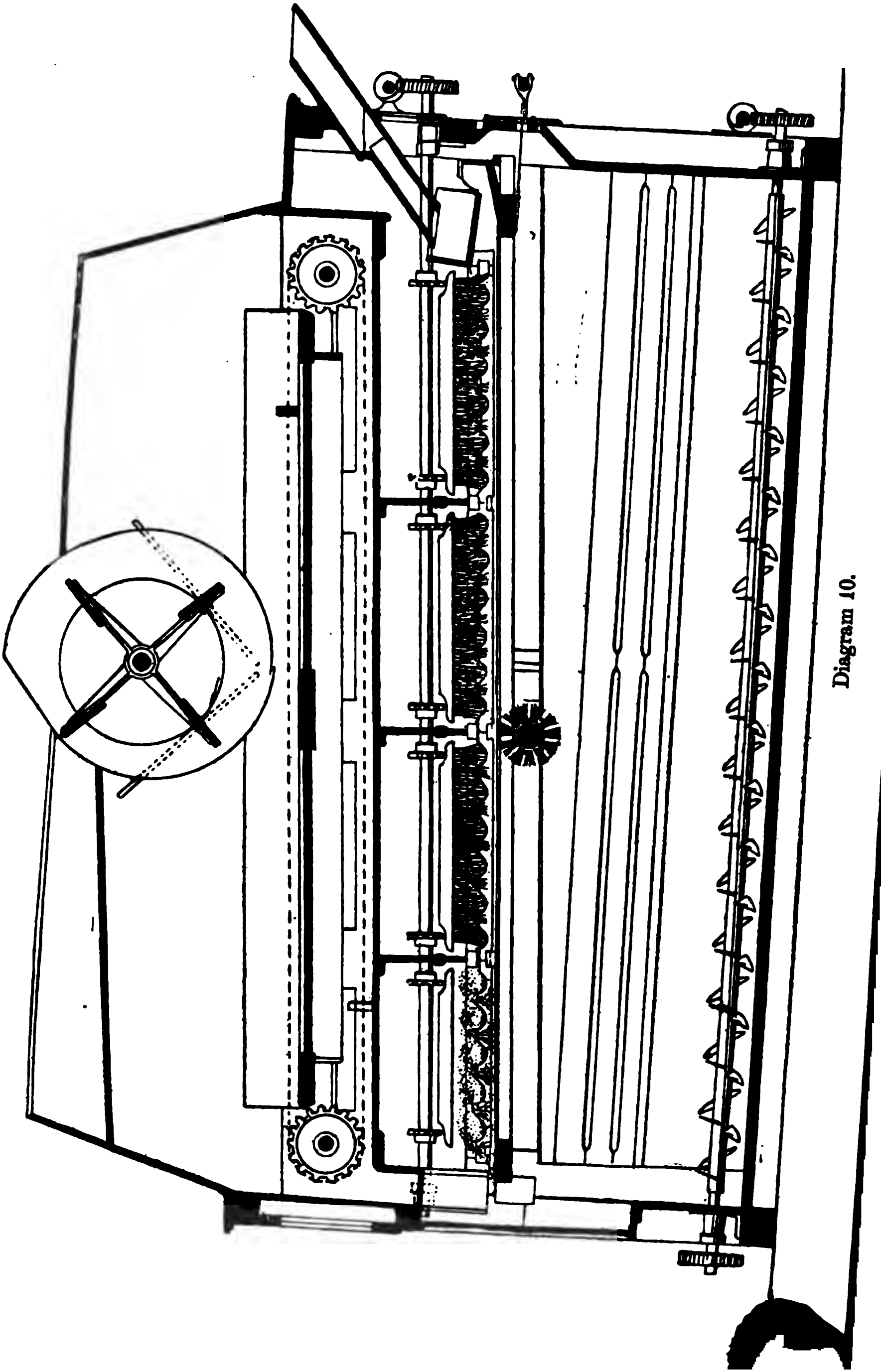


Diagram 10.

TURNERS' DUSTLESS PURIFIER

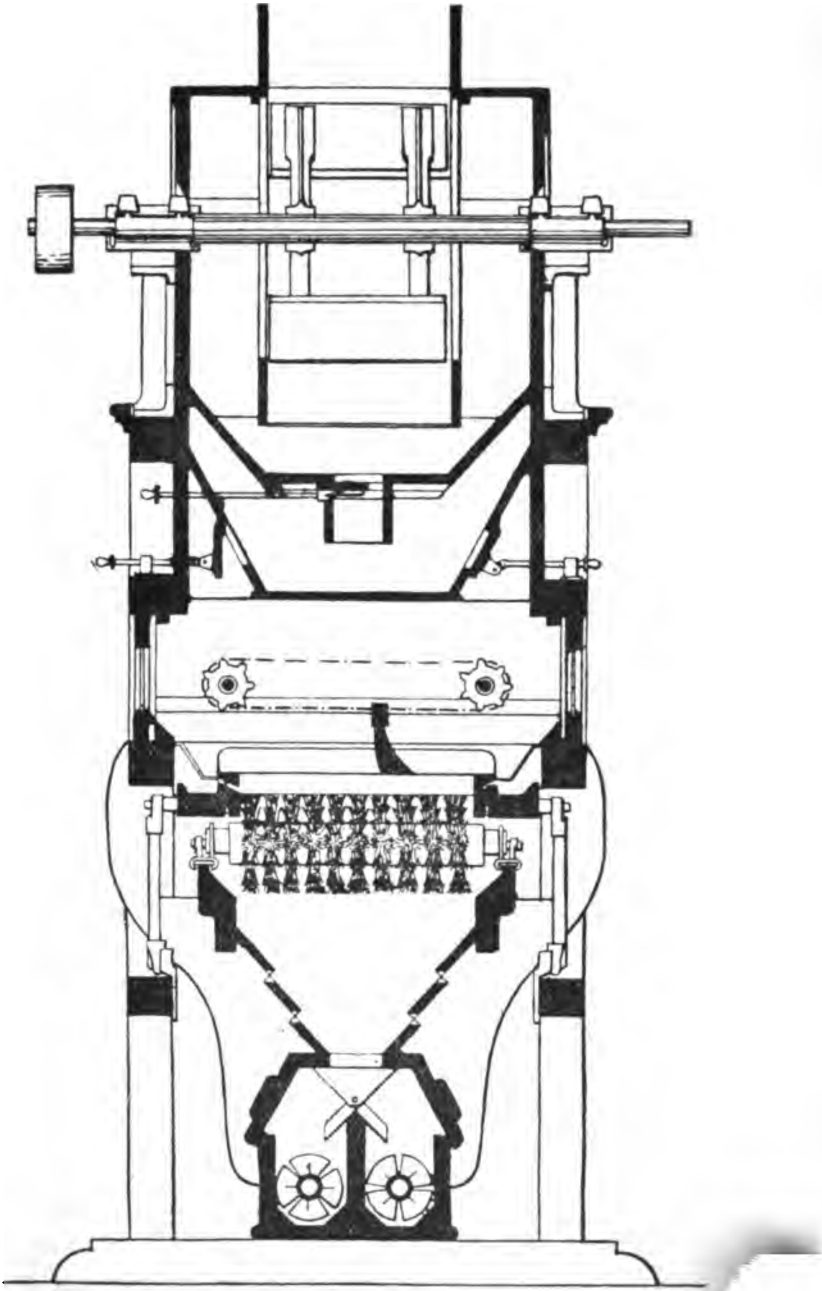


Diagram 11.

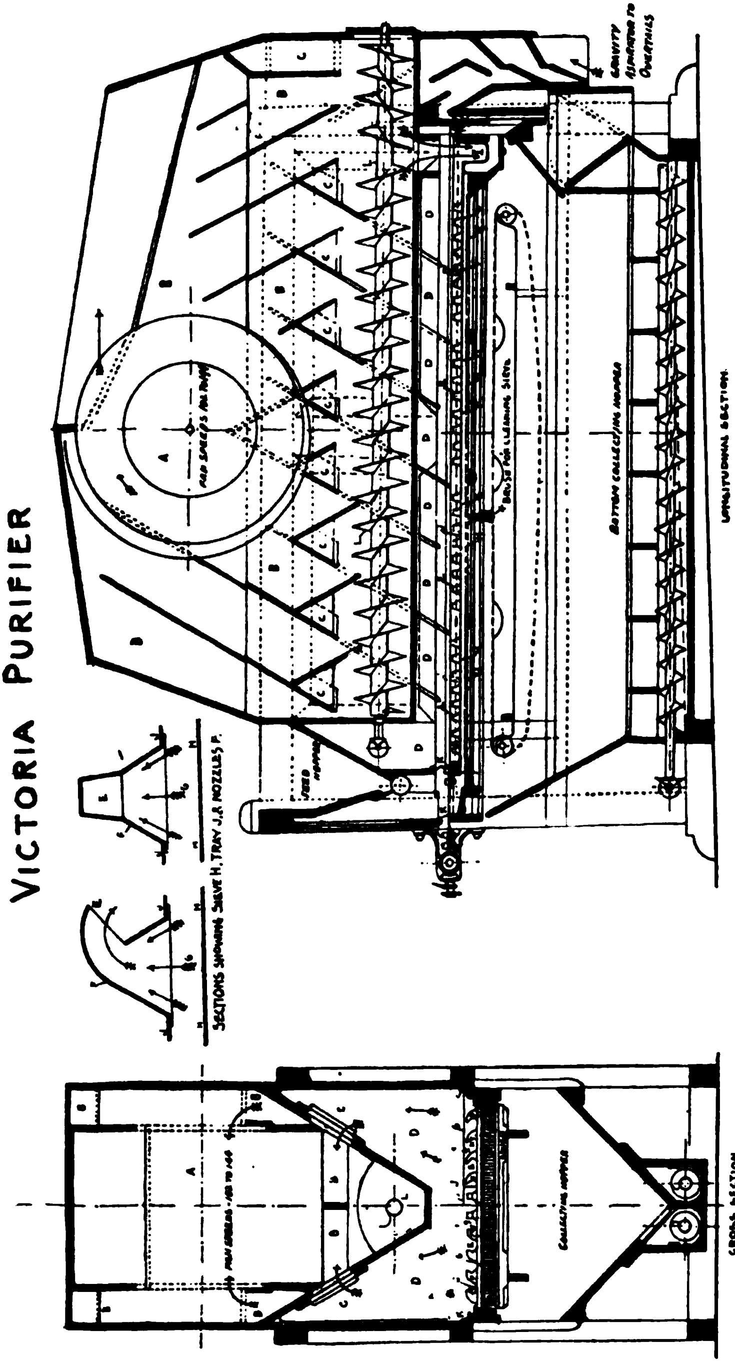

VICTORIA PURIFIER
SECTIONS SHOWING SIEVE H, TRAY J, & NOZZLES F.
FEED HOPPER
BRUSH FOR CLEANING SIEVE
BOTTOM COLLECTING HOPPER
GRAVITY ASPIRATOR TO OVERTAILS
LONGITUDINAL SECTION
COLLECTING HOPPER
CROSS SECTION

Diagram 12.

THE KOH-I-NOOR PURIFIER.

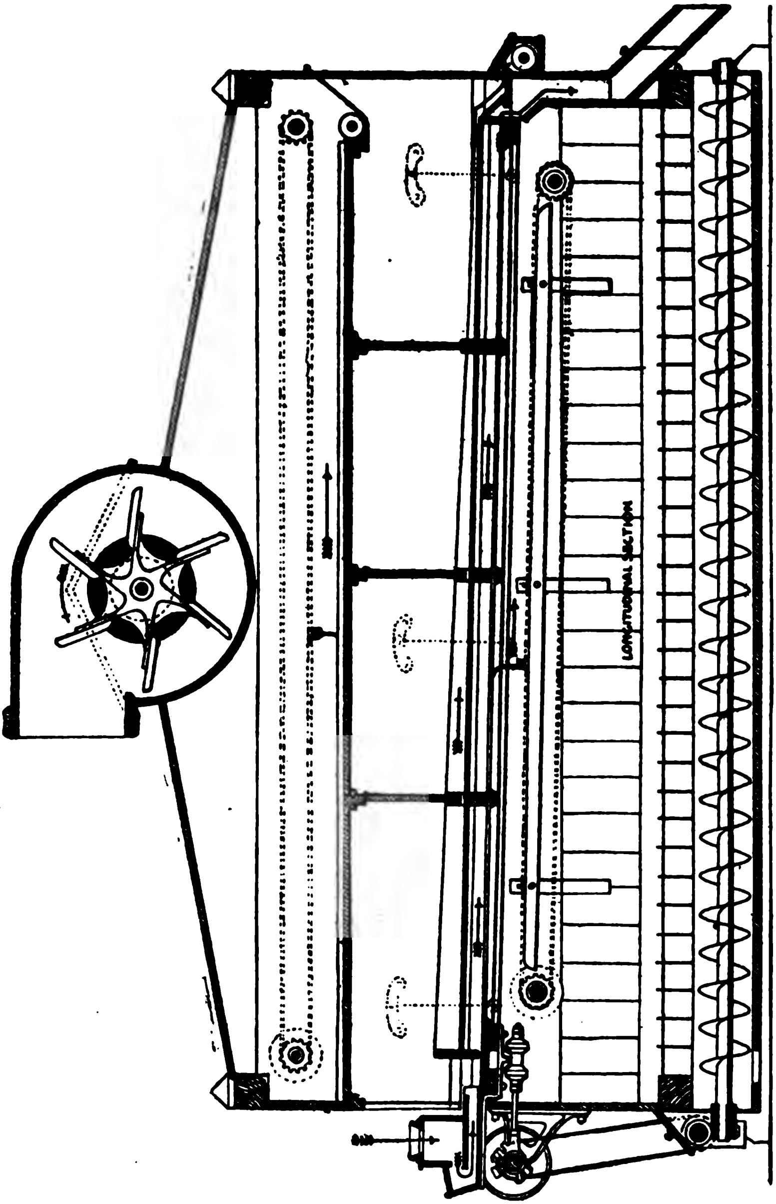
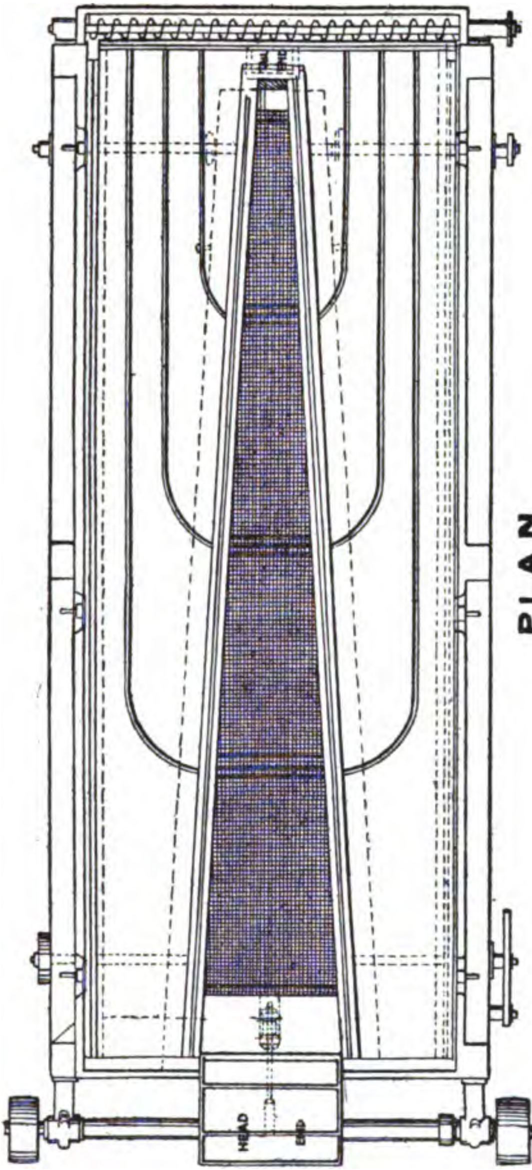


Diagram 13.

THE KOH-I-NOOR PURIFIER.



PLAN

Diagram 14.

Dust Collector.

For the purpose of collecting the dust from machines a contrivance has recently been invented which is applicable to any kind of mill where it is desired to free the air from dust or fluff, with a view either to comfort or to the prevention of waste.

The machine, which is called the "Cyclone Dust Collector," consists mainly of a plain inverted conical chamber of sheet iron, in the form of an inverted wine filler. The dust-laden air, driven by an exhaust fan through a wind trunk, enters the dust collector, as shown in plan No. 15, through the inlet spout at the top, and being forced against the surface of the cone, is made to revolve in a spiral direction downwards. By the action of the air current and by centrifugal force, the particles of dust keep close to the conical surface and are swept round and round, gradually reaching the opening at the bottom, where they pass out and are collected. The volume of purified air, on the other hand, finding itself confined as it works down the cone, turns upward in the centre and escapes through the central tube at the top of the apparatus.

The Cyclone, indeed, is simply nothing more than a dust receiver of a peculiar form, and, having no moving parts, is practically free from wear and tear. It also does away with the great objection to all previous dust collectors which strain the air through cloths or flannels—namely, that the latter obstruct the free passage of the air and gradually become filled up with dust, which, with the moisture of the atmosphere, forms a paste and renders the cloth useless after a few months.

Elevators.

An elevator, as the name implies, is an arrangement for lifting or raising material from a low level to a higher level.

Diagram No. 16 will readily explain the nature of elevators, which are very numerous and form an important feature in all roller mills; for there is one elevator to each set of rolls, and some of the elevators extend from the lowest level to the highest point in a mill.

As shown on the diagram referred to, an elevator is simply an endless band or belt, usually about 5 inches broad, to which buckets are attached by means of small bolts at intervals of about

12 or 14 inches. The belt or band is carried at the top by an iron pulley, which has a rim or flange to prevent the belt from slipping off, and each elevator should be driven by a separate belt. In some mills the elevators are hung on lines of shafting, which is an objectionable arrangement, for in the event of an elevator becoming choked, the friction may be sufficiently great to cause a fire. The advantage of driving each elevator by a small independent belt is, as pointed out by Mr. Simons, who is a well-known authority on roller mills, that if the elevator should cease to travel, the small belt slips off and there is no danger, whereas, with a number of elevators hung on one line of shafting, it is obvious that in the event of any friction taking place, the danger would be in proportion to the power employed to drive the shaft or elevator. The discharge spout from the elevator head should be a few inches below the bottom of the pulley, to obtain a perfect discharge of grain from the buckets, and the diagram shows the elevator head to be furnished with a "sprinkler." The buckets, of which there is a sample shown, are made of tin or sheet iron, and they are secured to the belts by means of bolts. The working of an elevator, like all the other machinery in a roller mill, is entirely hid from view, being encased in wood legs or spouts from top to bottom. It occurs to me that some improvement might be effected by having the legs made of sheet iron, which would not only reduce the quantity of combustible material, but also lessen the means of communicating fire from one flat to another.

In any case, whether the legs are of wood or iron, an arrangement could be effected by having the front of the elevator glazed at intervals with glass, say for the length of a few feet in each flat, which would afford the means of seeing how the elevator was working, and in the event of any breakdown or obstruction taking place, the glass could be broken at once, and in this way an accident would be discovered at the earliest possible moment.

In order to convey some idea of the extent of elevators required in a mill, I may remark that for a mill with, say, 40 sets of rollers, the total length of elevators would not be under 4000 feet, or fully three-quarters of a mile in length, if placed end to end.

Conveyors.

While elevators are the means of conveying grain from one floor to another, the conveyor, of which there are two kinds, carries grain in a horizontal direction.

CYCLONE DUST COLLECTOR.

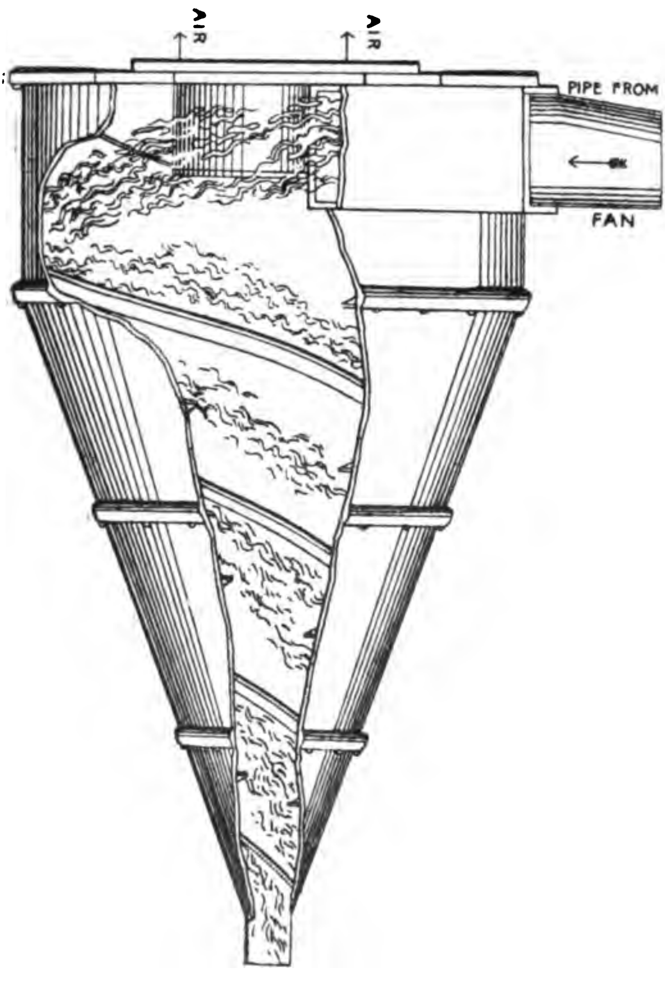


Diagram 15.

ELÉVATOR

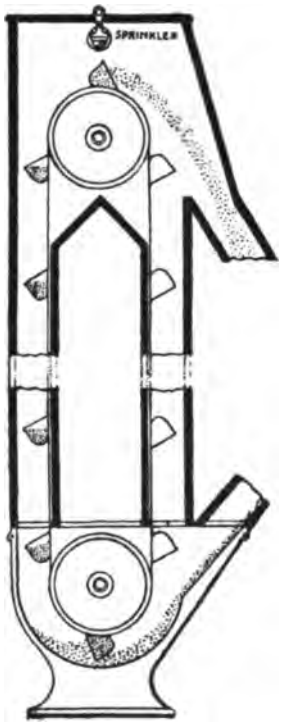


Diagram 16.

There are two kinds of conveyers—the worm conveyor and the belt or band conveyor, and, like the elevators, they are also encased in wood boxes.

The worm conveyor has a wood or metal centre or shaft with a continuous worm or paddle blades attached, such as may be seen in the diagrams of the reels and purifiers, while the band or belt conveyor is simply a flat belt. The speed of the worm conveyor is from 60 to 140 revolutions per minute, according to size, while a belt conveyor for flour travels at the rate of 7 to 8 feet per second, or about a mile in 12 minutes.

Description of Roller Mill.

The old system of grinding by stones has been in operation for ages, and the improvements which have taken place within recent years relate chiefly to the dress or separation of the offals from the flour by the employment of cylinders lined with silk instead of wire in the dressing machines.

This system produces flour of one "run" or quality, and does not offer facilities for the production of flours of high, medium, and low grades from the same wheat. Unless care is taken in grinding to keep the stones sufficiently high, the flour is apt to be "dead" or "killed," that is to lack anything approaching a granular character, owing to the stones being employed too close together. On the other hand, if the stones are worked too high, a loss results from all the flour not being removed from the bran. It is inseparable from this grinding system that some of the outer skin or bran is also torn or ground into flour, and thus preventing the attainment of perfection of colour.

The use of rollers in lieu of millstones dates back to the year 1820, when Collier of Paris and others erected flour mills fitted with rolls instead of stones. These mills, however, did not succeed, though it seems the fault lay rather with the machines than in the system of reduction by rolls. In 1830, Sulzberger, in Switzerland, succeeded in constructing a roller machine on an improved system, and established a company for the purpose of introducing roller machines throughout the continent of Europe, when many mills were built in Milan, Venice, Stettin, Pesth, and other places, working for a time with success, but latterly nearly all these mills failed or adopted the old system of grinding. The cause of this failure was ascribed to the impossibility of finding a

sufficient number of skilled workmen to work the mills, and it seems that only the Pester Cylinder Mill eventually succeeded and continued to work this system with profit.

The Sulzberger machine consisted of three pairs of rolls, arranged one pair above the other. Each roll was 6 inches in diameter and contained 200 grooves in the circumference. The motion was differential, the usual speed for the slow roll being 216 and the fast roll 229.

The first complete remodelled roller mill was, without doubt, the reconstructed Pesth Cylinder Mills, which began to work in 1867. This mill had 210 pairs of rolls arranged in five sections; two of these sections were arranged for the production of middlings and the other three for reducing middlings into flour. Until 1864 only one mill in Venice, one in Switzerland, and one in Austria had adopted this system on a smaller scale, but it is admitted that the Pesth Cylinder Mill was the first prominent success in this direction.

By the roller system, flour is produced by cutting or squeezing the grain through a series of rollers, as distinguished from the tearing or grinding of millstones. The wheat is first cracked, after first being cleaned, through a first set of rolls and its sieve or scalper, which separates a small quantity of flour and dirt, the latter being liberated out of the crease of the wheat, and is not removable by any system of brushing or blowing. The cracked or purified wheat is then passed on through other sets of rolls and sieves and rendered into middlings and flour. From these middlings the higher grades of flour are made; they are first freed from all light particles of the skin by being passed through "purifiers," and then through several successive sets of rolls and sieves, each set yielding flour of a different grade. Each grade may be kept separate or caused to run together into a mixing worm, and so become one run of flour. A leading feature in this system is that the germ of the wheat is not torn or ground into flour as it is by grinding under stones, for the action of the rollers is to squeeze or flatten it, and from its soft nature to increase its size, thus rendering its separation from the flour easy. The advantages of the system are—less liability to "kill" or destroy the granular nature of the flour, the removal of the dirt found in the creases of the wheat, and the separation of the germ, thus rendering the attainment possible of a high standard in the character of the flour. At the same time it is attended with a

slightly increased yield of offals, which of course means the quantity of wheat required to produce a sack of flour must be proportionately increased, in the proportion, it is said, of, say, 400 lbs. of wheat for rollers against 380 lbs. for stones.

There is little to be gained by a casual inspection of a roller mill, for the whole process is hid from view, and in this respect a roller mill presents a striking contrast to any other class of mill. For instance, in a cotton or a woollen mill we see the material passing through the various processes from the raw state till it reaches the finished stage, and it will be observed that the various machines are self-contained in the sense that there is no communication with any other machine, for the various machines in such mills are supplied by manual labour. In the roller mill, however, the whole machinery is continuous throughout, and the grain, from the time it leaves the wheat bin or store till it reaches the flour sack in its finished condition, follows an uninterrupted and unbroken course entirely hid from view. In reality the general principle of all roller mills is identical; they differ only in the mode in which they are carried out according to the owners' ideas. They consist in breaking the wheat by degrees, so as to produce as little flour as possible by each operation, in order that the flour might ultimately be produced by the smooth rolls from the granular portions of the grain after these had been separated in the purest condition. In the old system grinding and sifting were the sole means of production, and while, no doubt, of late a few purifiers have found their way into the stone mills, these were the exception and not the rule. The new system adds winnowing, and instead of crushing the grain at one operation and compelling it to remain under severe pressure for some minutes, the roller does the work required of it in an instant, and at one point of contact, when the grain escapes without friction and in a positively cool condition. Further, instead of grinding the grain with many of its impurities, the roller system grinds gradually, first loosening the impurities and at once removing them, and only grinding to flour when a perfectly pure article has been reached.

Fire Risk.

The fire risk of a roller mill is, I think, to be found mainly in the preliminary or cleaning process, where the smutter and brush

machines with their fans run at a high rate of speed, and it would be advisable to encourage the introduction of Cyclone dust collectors to replace stive rooms. In the Cyclone dust collector the dust settles down at once, whereas in a dust room or stive room the dust remains for some time at least in suspension, and in this state it is liable under certain conditions to explosion. It would also be advisable to place dust collectors as near as possible to the machines with which they are connected, for the trunks or spouts leading from the fans to the collectors, or stive rooms, as the case may be, are filled with dust in suspension and are therefore practically miniature dust rooms. In any case where dust rooms are indispensable they should be placed outside the main building, and constructed in such a slender fashion that, when an explosion happens, it would cause the least amount of damage.

I am indebted to the following firms for the drawings which are displayed here, and without which I feel that any description of the process would have been comparatively uninteresting:—

Messrs. WALWORTH & Co., Bradford—Drawing of wheat washer and drying kiln.

Messrs. E. R. & F. TURNER, London—Drawings of purifiers and dressing machines.

Messrs. HIGGINBOTHAM & Co., Liverpool—Drawings of Victoria Purifier, with photograph.

Messrs. ROBINSON & SON, Bradford — Wheat cleaning and milling machinery.

Messrs. W. R. DELL & SON, London—Drawing of Victoria Brush Machine.

I have only to add that I have obtained from Captain PATERSON, of the Glasgow Fire Brigade, a list of the fires which have happened in mills in Glasgow since 1870, which I purpose adding as an Appendix to this paper. From this list it will be seen that there have been 31 fires in connection with mills during that period, including two explosions, one being at the Tradeston Mills in July, 1872, which resulted in a very serious loss, while the other explosion was in the smut-house of the City Flour Mills at Port-Dundas in September, 1874.

It will also be observed in the 31 fires referred to that three mills had three fires each and six mills had two fires each, while

ten mills had one fire each—making in all 31 fires during that period.

As an addition to the Appendix, a Glossary of Milling Terms will be found, which I hope will be useful for reference.

ALEXR. B. DANSKEN,
Assessor of Fire Losses, Glasgow.

Insurance and Actuarial Society of Glasgow,
April 25th, 1892.

Fires Attended in Flour Mills in Glasgow from 1870 to 1892.

Date.	Time. A.M.	Time. P.M.	Name and Locality.	Cause.
1870.				
March 15th	8-45		M'Naughton & Stevenson, 21 West Street, S.S.	
1871.				
May 22nd		10-50	J. Thomson, Rockvilla, Possil Road.	
1872.				
July 9th		4-15	M. Muir & Son, 6 to 10 Commerce Street.	Explosion.
Sept. 19th		11-40	M. & A. Clark, 98 Elliot Street.	
Oct. 10th		5-17	J. Arthur, Jun., 16 Commercial Road.	
Dec. 8th	12 30		T. Stevenson, 14 Market Street (East).	
1874.				
April 26th		10	M. & A. Clark, 98 Elliot Street,	Spark from chimney.
Sept. 16th		12-15	W. Hay & Son, 204 Spiers' Wharf,	Explosion.
1875.				
Aug. 4th		12-30	Stevenson & Coats, 23 West Street, S.S.,	Unknown.
1876.				
July 15th	1-45		Harvey & M'Gavin, 27 Washington Street,	Defective vent.
1877.				
Dec. 24th	3		J. Arthur, Jun., 16 Commercial Road,	Unknown.
1878.				
April 13th	9-30		W. Primrose, 49 Centre Street,	Unknown.
1879.				
March 16th		1-15	M. Muir & Son, 6 to 10 Commerce Street,	Heat from furnace.
1880.				
Oct. 15th	3		J. Marshall, M'Lellan Street, Ibrox,	Unknown.
1881.				
Feby. 1st	9-40		R. H. Hay Bros., 95 James Street (East),	Friction of machinery.
May 13th		2	W. Primrose, 49 Centre Street,	Do.
July 26th	10		George Coats & Co., 21 West Street,	Do.
Oct. 12th	4-35		Incorporation of Bakers, Old Dumbarton Road,	Do.
1882.				
Aug. 2nd	12-45		R. H. Hay Bros., 95 James Street (East),	Unknown.
1883.				
May 22nd	2-5		J. Kerr & Co., 47 Kerr Street, Calton,	Friction of machinery.
June 14th	2-15		Do. do.	Incendiarism.
,, 15th	12-10		Do. do.	Do.
1884.				
Feby. 4th		7-15	J. & R. Snodgrass, 90 Washington Street,	Dust contact with light.
April 28th		3	A. R. Tod, Crownpoint,	Plumbers at work.
1886.				
Feby. 4th		5-55	R. Geddes & Son, Port-Dundas,	Spark from chimney.
,, 6th		4-50	W. Ferguson, Old Dumbarton Road,	Unknown.
June 18th		9-40	A. & W. Glen, 71 Cheapside Street,	Unknown.
1887.				
Feby. 22nd	11-55		Gavin Ralston, 124 Hill Street (East),	Heat from kiln.
1890.				
Sept. 24th	4-25		J. Ure & Son, 66 Washington Street,	Spark from fire.
	3-50		Do. Do.	Unknown.
1892.				
Feby. 27th		1	W. Primrose & Son. 107 Centre Street,	Unknown.

GLOSSARY OF MILLING TERMS.

ARCHIMEDEAN SCREW OR WORM CONVEYOR.—A spiral wound round an axis or centre, generally enclosed in a wood casing or box. Speed from 100 to 150 revolutions per minute.

ASPIRATOR.—A wind purifier without sieves.

AUTOMATIC FEED.—A self-acting arrangement to regulate the feed to various machines as applied to rolls to prevent chokes; also to provide against the rolls running empty.

BAKERS.—An American term, generally applied to flour after the Patent flour is taken out.

BALANCE OR RHIND.—An iron bridge or beam by which the upper stone is hung.

BARLEY MILL.—A mill with one stone running under a wire cap, revolving in the opposite direction. Speed about 600 revolutions per minute.

BEDDING.—The wood or metal bed under the stone.

BELT CONVEYOR.—A means of conveying grain on the upper surface of a broad belt, usually from 12 inches to 18 inches wide. Sometimes called a Creeper. Speed about 7 or 8 feet per second.

BLAST.—Air driven by a fan into an apartment or machine.

BOLT.—To dress meal; a reel or dressing machine.

BOLTING CHEST.—A set of flour-dressing machines in one frame.

BOLTING CLOTH.—The silk covering of a bolting reel.

BOXINGS.—Wood casings round cog wheels and journals.

BRAN.—The outer skin of the grain.

BRAN DUSTER.—A wire reel for dressing bran, revolving about 400 revolutions per minute.

BRAN FLATTENER.—A pair of smooth rolls with heavy pressure, running without differential speed, for improving the bran.

BRAN ROLL.—A fine grooved roll for cleaning bran, usually with about 32 grooves to the inch.

BRANNY SEMOLINA.—Semolina containing particles of bran.

BREAKS.—The several reductions or granulations of the wheat-berry by the roller process.

BREAK FLOUR.—Inferior flour from the grist breaks.

BREAK ROLLS.—Corrugated fluted rolls by which the reductions are made, 8 to 24 to the inch.

BRUSH MACHINE.—Generally a wheat-cleaning machine containing a revolving brush within a perforated screen.

BUCKETS.—Made of tin or sheet-iron, for elevators.

BUNTING.—The woollen stuff with which stive rooms are covered.

CENTRIFUGAL.—A flour-dressing reel or cylinder, with revolving beaters inside, to drive the fine flour through the silk. The speed is about 200 revolutions for beaters and 20 for reel.

CHOP.—Outsiftings from the scalpers.

CLEANING HOUSE.—Sometimes outside the mill, and contains the brushing and scouring machine, through which the grain passes before going to the rolls.

CLOTHING.—Silk or wire covering of reels.

COCKLE.—Small round black seeds found amongst wheat.

COCKLE CYLINDER.—Zinc cylinders, with indentations, to separate the cockle. Speed, 10 to 15 revolutions per minute.

COCKLE SEPARATOR.—Cylinder, or sieves, for separating cockle.

COCKHEAD.—The wearing point or pivot of a mill spindle.

CRACKING.—Splitting or breaking the wheat, generally applied to the first break on stones; also to the dressing of stones.

CREASE.—The split in the side of the wheat-berry.

CUT-OFF.—The slide draw-off spout at the division of the clothing on a reel or purifier.

DECORTICATING.—Husking the wheat without splitting the grain.

DECORTICATOR.—Machine for decorticating by steel plates or emery wheels. Not much used.

DETACHEUR.—A disintegrator for breaking up the flakes of flour produced when equal-speeded smooth rolls are used.

DISINTEGRATOR.—A machine revolving at a high speed, which reduces, by force of percussion, the material into powder; in milling, chiefly used for maize, but not in flour mills. Goes at a high rate of speed, varying, according to size, from 1500 to 3000 revolutions per minute.

DRESS.—The form of the corrugation, or furrows, of a mill-stone or disc.

DRIVING IRONS.—A crossbar on the spindle to drive the stones.

DUNST.—German for middlings.

DUST COLLECTOR.—A machine into which the fan blows the dust from the purifiers. Used as a substitute for stive rooms, &c. The clothing is shaken or cleansed by intermittent mechanism.

ELEVATOR.—Belt, with buckets attached, for lifting material. Encased in wooden legs or spouts; the speed being from 250 to 350 feet per minute.

EXCELSIOR.—The name applied to a special make of machines.

EXHAUST FAN.—Fan suction from any machine; speed varying from 1000 to 2000 revolutions per minute.

EUREKA.—Name given to a special make of wheat-cleaning machinery.

FACE.—Applied to the width of a pulley, or the working side of a millstone.

FURROW.—The grooving of a millstone.

GARDEN CITY.—The name given to a special make of American machines.

GERM.—The seed of the wheat grain, or germinating part.

GERMY SEMOLINA.—The product from wind purifiers.

GRADUAL REDUCTION.—A method of grinding by reducing the wheat gradually at several operations.

GRAIN DRYER.—A machine for drying grain, combined with a washing machine, such as made by Walworth & Co.

GRANULATING.—Breaking into grains.

GRADER.—A machine for grading wheat or middlings into sizes.

GRADING REEL.—A reel for grading the chop after the breaks.

Grooved Rolls.—Rolls used for the breaks and for bran.

Grit Gauge.—A superior quality of silk.

Grist.—A grinding.

High Grinding.—Grinding by more than one operation with stones, or when the weight of the stones is partly carried by the spindle and not by the wheat alone, such as with under-runners; in contradistinction to low grinding.

Hopper.—A feed bin, angled towards the bottom or outlet.

Hurst.—The framing for millstones and gearing.

Kibbling Mill.—A small mill for crushing or grinding feeding stuffs.

Joggler.—A shaking sieve, supported by wooden springs, and driven by a crank or eccentric.

Land.—The portion of a millstone between the furrows.

Low Grade.—Low-quality flour.

Low Grinding.—Grinding at one operation with stones, the weight of the stone being carried by the wheat alone.

Magnets.—A set of revolving or fixed magnets to extract metal, such as wire and nails, from the wheat before grinding.

Meal.—The whole product from the stones before dressing.

Middlings.—Granulated semolina.

Millstone Driver.—See Driving Irons.

Millstone Spindle.—The upright shaft which drives the stones.

Millstone Staff.—A wood or iron disc, or straight piece of timber, used for trueing up the millstone face.

Mixer.—An arrangement for mixing various wheats or flours in required proportions.

Offals.—Generally understood to consist of all products after the flour is separated, or sometimes to consist of the bran and germ.

Out of Wind.—Applied to stones when out of truth.

Outsiftings.—The fine material passed through the clothing of a dressing reel.

Overtails.—The coarse material passed over the tail end of a dressing machine or purifier.

Paddle Worm.—A worm conveyor, with separate reversible blades, to run right or left hand.

Packer.—A sacking machine or sack packer, used chiefly in America for export flour.

Patents.—The finest quality of flour obtained by the roller process.

Penny's Grader.—A wire cylinder for grading wheat.

Polisher.—A machine for cleaning the exterior of wheat grain, similar in principle to the decorticator.

Pollard.—Small bran, fine and coarse.

Porcelain Roll.—Smooth rolls with porcelain shells.

Posser.—An ordinary flour packer by which the flour is not forcibly packed. Generally used for home consumpt.

Provender Mill.—A mill of a general character, for operating upon beans, maize, oats, &c.

Purifier.—A machine by which middlings and flour are purified from fine fluffy dust by gravity and suction, with an arrangement of sieves and fans.

RANDAN.—Coarse pollard.

REEL.—A flour-dressing machine—a revolving sieve.

RICE MACHINE.—Rice or barley mill with revolving stone encased in wire sieves. Speed, 200 revolutions per minute.

SCALPER.—A wire-clothed reel used to scalp or dress the chop from the break rolls.

SCRATCH ROLL.—A fine-grooved roll, with flattened flutes, for cleaning the bran.

SCREENS.—Applied generally to wheat-cleaning machines or machines for screening the dust from the wheat.

SCREEN ROOM.—The room separated from the mill containing the cleaning machinery.

SCOURER.—A machine, on the principle of the polisher, for scouring off the husk of the grain.

SCHROT.—German for grinding by a semi-rotary motion.

SCHROT MACHINE.—A reduction machine on the principle of the disintegrator.

SEPARATOR.—A wheat-cleaning machine which separates refuse, &c., from wheat.

SEMOLINA.—The granulated kernel of the wheat berry, containing the most nutriment.

SHARPS.—Thirds, or the quality between fine pollard and flour.

SHORTS.—Refuse from the bran duster.

SILK CLOTHING.—Made with 18 to 180 threads per lineal inch, and from 30 to 40 inches wide, the piece being about 50 yards.

SILO.—A warehouse wheat-storage bin.

SIZER.—A grader.

SPATULA.—A horn or ivory flat spoon for handling flour samples for testing colour, &c.

SPEEDS OF MACHINERY :—

	Revolutions per Min.
Band conveyors (9-inch pulleys),	45 to 50
Bran dusters,	400
Bran sifters,	250
Centrifugal,	180 to 200
Elevators (12-inch pulleys),	55 to 60
Exhaust fans,	600
Purifiers,	200
Rolls,	180 to 200
Stones,	120 to 180
Vertical machines,	600 to 800
Wheat worms,	90

STIVE ROOM.—A frame or room clothed with bunting, into which the dust from the purifiers, &c., is discharged.

STONING.—Extracting stones from the wheat during the washing.

STRAIGHT GRADE.—One grade of flour in contradistinction to several grades—generally all flours up to 70 per cent.

SMOOTH ROLLS.—Rolls for reducing middlings.

SMUT.—Dust of wheat produced from diseased ears.

SMUTTER.—Wheat-cleaning machine to clean the wheat from dust.

TAILINGS.—See Overtails.

TRYUER CYLINDERS.—Barley and cockle cylinders or separators.

UNDER-RUNNER.—When the upper stone of a pair is stationary and the bottom one revolves, they are said to be under-runners.

VICTOR.—The name of a particular make of machine; generally applied to the Victor wheat-cleaning machine.

WASHER.—Wheat-washing machine.

WIRE CLOTH.—Made of steel or brass wire, and numbered according to the number of wires per lineal inch. The fine cloth is made of brass. Iron wire is used up to 40, and steel wire up to 80, while brass or copper wire is made up to 120 per inch.

WEGMANN.—The name of the patentee of the porcelain roll; applied generally to porcelain rolls.

WHIZZER.—Centrifugal wheat-drying machine.

WORM.—A screw conveyor.

A. B. D.

THE COST PRICE OF FIRE INSURANCE.

THE consideration of the cost price of Fire Insurance suggests many and wide issues. I have attempted to so treat the subject as to interest the younger members of this Institute, rather than in any ambitious hope of instructing the senior members, to whom my remarks will merely recall their own conclusions in bygone years.

The published accounts of our British Fire Insurance Companies for the ten years ending 1895 afford us a reliable indication of the cost of Fire Insurance in the aggregate, thus :—

		Ratios to Premiums.
Premiums	£164,500,000	—
Losses	99,700,000	60·6 per cent.
Provision for Unexpired Risks (say 40 per cent. of increase in premiums) .	1,950,000	1·2 per cent.
Agency Commission . .	26,600,000	16·1 per cent.
Expenses	25,580,000	15·5 per cent.
Profit	10,670,000	6·5 per cent.

In correspondence with the above loss ratio (60·6 per cent.) it has been stated that 30 Companies received in premiums during seven years, 1870-76, about 37½ millions sterling, and paid away for losses by fire about 22 millions, or 58·7 per cent. of the premiums received. By adding together the results of these two periods we obtain a loss ratio (without provision for unexpired risks) of 60·2 per cent. on £200,000,000 of premiums; or, to take the experience of a single Company over a much longer period, we find that the losses during 60 years were 59 per cent. of premiums, or, after making the provision for unexpired risks, 60·8 per cent.

Now, if a comparison were to be drawn between the business of Fire Insurance and that of an ordinary trader, we might say that the commodity sold by the Fire Offices is protection against loss by fire, that the cost price is represented by the amount paid in satisfaction of claims, together with a proper estimate of losses under the unexpired risks for which premiums have been received in advance, and that the selling price is represented by the premiums. From this point of view we should rearrange the figures first quoted in this manner:—

		Ratios to Cost Price.	
Losses	£99,700,000	—	
Provision for Unexpired Risks	1,950,000	—	
Cost Price	£101,650,000	—	
Commission	26,600,000	26·2 per cent.	51·4 p.c.
Expenses	25,580,000	25·2 per cent.	
Profit	10,670,000	10·5 per cent.	
Selling Price—Premiums	£164,500,000	161·9 per cent.	

But it may be argued that commission—the amount paid away to the intermediary agency through which the business is acquired, ought to be included in the cost price. Then we should have the following result:—

		Ratios to Cost Price.
Losses and provision for Unexpired Risks	£101,650,000	——
Commission	26,600,000	——
Cost price	£128,250,000	——
Expenses	25,580,000	19·9 per cent.
Profit	10,670,000	8·3 per cent.
Selling Price—Premiums	£164,500,000	128·2 per cent.

In considering such comparisons, we have, however, to keep in mind one of the important distinctions between Fire Insurance and the transactions of trade. Not only is the cost to the Fire Office a variable and uncertain quantity, but also the selling price has to be fixed in advance, so that an element of speculation special to the business has to be regarded. Further, the uncertainty of the cost price, and the possibility of an extraordinary and sudden rise in the same at any time, renders necessary to the security of both buyer and seller the maintenance of a substantial reserve, in order that the supply of the commodity for which payment has been received in advance may not fail on account of its cost, plus expenses, exceeding the selling price. The published figures which I have quoted relate, of course, to the aggregate business of the British Offices, without distinction of Home, Foreign, and Colonial business, or between the many well-recognised classes of risks. Such results are, therefore, of too general a character to afford definite guidance to the underwriter, who, in these days, aims to make each section of the business under his control contribute, in something like fair proportion, its quota of profit.

It is fortunate that the shrewd men who in the seventeenth century laid the foundation of modern Fire Insurance were content to proceed on simple lines rather than to rashly attempt, without the light of experience, an elaborate system which might have cost their successors infinite trouble to destroy and reconstruct. Beginning with caution, they at first accepted only buildings, and these they divided into but two classes, "brick houses" and "timber houses," avoiding altogether such as might be occupied for specially hazardous trades. After some years they undertook to systematically insure goods and merchandise. Next followed the further distinction of "half-hazardous" and "hazardous" risks, and this came to be supplemented by the more definite exclusion of trades which were deemed to be extra hazardous and of buildings recognised to be specially endangered by situation or environment. By such successive steps, extending over half a century, the way was prepared for that settled classification which, with modifications, lasted for a hundred and fifty years, and which we all remember as retaining the place of honour in our older prospectuses. In its original form this classification was:—

(1) Common Insurance:—Brick and tile buildings in which no hazardous trades nor hazardous contents.
(2) Hazardous:—Timber buildings in which no hazardous trades, &c.; brick and tile buildings in which hazardous trade or hazardous contents.
(3) Doubly Hazardous:—Timber buildings in which hazardous trades, &c.; thatched buildings.

To these had to be added, as time went on, another class, which we may call the "extra hazardous"—sugar works, distilleries, manufacturing chemists, flax dressers, floor cloth manufacturers, cotton, flax, or lint mills, and others; also manufacturing premises containing stoves, kilns, or steam power. All these came to be admitted within the range of insurance at rates fixed by the judgment of the underwriter. Thus the history of the practice of Fire Insurance is one of evolution, stimulated, as in nature, by the struggle for existence, and resulting in the survival of the fittest.

By slow degrees, often as one of the sweet uses of adversity, it has come to be perceived that in proportion to the growing stress of competition arises the necessity for vigilant ascertainment of the cost price of each section of business and the reasonable adjustment to each of the selling price, so that the margin for expenses and profit may, as far as practicable, be equitably spread, that the public may be without just cause of complaint, and that underselling may be perilous to the aggressor. In commercial life the prudent trader foresees that if he recklessly sells part of his goods below cost, relying on excessive profit from other sections of his stock, his position is insecure, sooner or later he will be found out, competition will focus itself upon the most profitable department, and his sources of special profit will fail him. In the Insurance window we have sometimes seen the notice, "Selling off regardless of cost; no reasonable offer refused," but such a system is not sound, nor is it in the long run advantageous to the public, whose demands are high quality of the article sold, and a reasonable price; in other words, absolute security and some degree of liberality in treatment of claims, at rates of premium fairly commensurate to the risk, with a moderate provision for profit. War rates are in the long run as unsatisfactory for the Insured as panic rates are for the Offices, because tending to produce violent reactions. Fire Insurance business can never attain to the precision of Life Assurance business with its

mortality tables and formulæ, but neither need it ever be degraded to the level of that kind of competition which Mr. Frederic Harrison characterises as "running amok in the great race of grab." No level-headed Insurance official will ever be led away by the sophistry that each separate insurance will, on any terms whatever, be profitable, so long as it does not produce a loss. But, after all, we are only human, and it is by the sharp discipline of occasional misfortune that we are kept in the straight course of prudence. As in commerce, temporary prosperity tends to undermine the dictates of experience. One of our Insurance journals has it thus:—"Good rates make insurance pay; paying "business makes new companies; new companies make competi- "tion; competition lowers rates; lower rates kill companies; few "companies, and competition is small; small competition makes "good rates; good rates make insurance pay; paying business "makes—(then the compositor became delirious)."

How narrow is the margin for the successful management of Fire Insurance business may be gathered from the fact that during the past ten years the profit (6·5 per cent. of premiums) has been applied in the ratio of 4·0 per cent. of premiums to the strengthening of the reserve funds, and only 2·5 per cent. of the premiums toward payment of shareholders' dividends; or, to quote from the paper read last year by the Borough Accountant of West Bromwich before the Corporate Treasurers' and Accountants' Institute:—"The average dividend paid by all British Offices "during the seven years ending 1895-96 was 7½ per cent. of the "funds employed in the business (paid-up capital and reserve "funds). Of this dividend only about one-fourth was derived "from trading profit, and about three-fourths (75·6 per cent.) was "derived from interest earnings and other outside sources of "income." The surplus of premiums for the seven years, after paying losses and expenses, but not dividends, was (allowing 40 per cent. for unearned premiums upon policies unexpired) 4·3 per cent.

In December 1885 the "Insurance News" published a list of 217 Insurance Companies that had been registered during the preceding quarter of a century; to-day only nine survive, and of these the majority are small Companies. The young Fire Office is, indeed, heavily handicaped. For some years the management has to meet a fixed expenditure which is necessarily disproportionate to a small and but slowly growing revenue; on the other hand, the

revenue cannot be built up both rapidly and economically, except at the price of great laxity in selection. In Fire business, as in Life business, there is selection against the Office which calls for constant vigilance, and it is upon the small and struggling Office that the adverse selection operates most severely. Good business can seldom be taken away from the old Offices unless lower terms can be offered, and influential agents cannot easily be persuaded, without special pecuniary inducement, to prefer to undertake the representation of unknown and untried Companies. All the while a profit has to be sought, sufficient not only to provide dividends for shareholders, but also to build up a reserve fund. And this unequal war has to be waged against Offices already holding strong reserves accumulated during long periods of prosperity, and become so well supplied by annual revenue from interest on their funds as to require only a slight profit on premiums to pay large dividends. There is every reason why the existing Companies should continue to conduct their business on the basis of very moderate average profit with due provision for stability, and why the commercial world, whose credit is largely dependent on insurance, should be well satisfied to enjoy the security on terms so favourable.

The conditions which affect the cost price of Fire Insurance have enormously changed during the present century. The employment of steam power, with the consequent introduction of the factory system, the increased facilities of transit and communication, the adoption of Free Trade, the wide extention of the Empire, and the long succession of inventions to provide for the requirements of a nation rapidly advancing in material comfort and purchasing power, as well as for the needs of vast populations abroad—all these have created demands upon the intelligence of Fire Insurance managers undreamed of by the pioneers in the business. In the rating of the complex manufacturing risks with which we now have to deal the latest advance is represented by our more recent tariffs. These have been framed with utmost care upon the basis of ascertained results drawn from experience far wider than that of any single Company, and so much the more reliable. In these tariffs we have, as the result of much consultation and compromise, the matured judgment of our most qualified experts, free from that element of uncertainty which might attach to individual opinions and from the unequal bias of more or less sanguine temperaments, for, to use the expression of Oliver Wendell Holmes,

"no individual mind is quite achromatic." And, indeed, it is easy to draw wrong conclusions from statistical records, however carefully prepared. Even the results of our Classification Registers need to be read with intelligence and applied with caution, or they may lead us astray. If all Offices could be induced to adopt a uniform system of classification the difficulty of readily ascertaining the aggregate cost price in any given class would, as the years go by, be greatly diminished.

The primary conception of the function of Fire Insurance is, of course, simply to grant protection against loss by fire, at rates proportionate to the degree of the supposed hazard; hence that no responsibility rests upon the Company to moderate that hazard. This strictly correct principle is to some extent qualified in practice by the policy which underlies our tariff system, for here we add to our function of insurers of risks that of educators and guides of the insured, we placing at their disposal the fruits of our experience and judgment in order that they may obtain their protection from us on the lowest terms consistent with their requirements. In the concise phrase of an eminent writer, we "affix such a penalty to dangerous constructions, substances, and "processes as to induce, if possible, a lessening of the danger. In "other words, and reversing the order, we seek to diminish the "risk of fire and to secure adequate payment for what risk "remains." But, in the case of premises protected by automatic sprinklers, Offices have recently entered a new field by practically taking charge of the risks which they insure, under a system of quarterly inspections. This form of business approaches in character to that of boiler "Insurance" so called, really what is paid for being inspection *plus* protection, the cost of the latter kept in check by the efficiency of the former.

In the United States a scheme of fire rating has been propounded under the name of "The Universal Mercantile Schedule," which, for boldness and ingenuity, leaves well behind all previous attempts in this direction. The method of building up the rate for a mercantile risk is by cumulating the net rates under three separate tariffs—(1) for the city, in relation to such features as water supply, fire-brigade resources, building law, construction of streets, conflagration hazard, previous fire record, liability to high winds, &c.; (2) for the building, as if unoccupied, in relation to many structural features, area, height, openings, lighting, heating, exposure, faults of management, age, &c.; (3) for occupancy

according to a list of about 300 trades and tenancies. The scheme is elaborated with a completeness to which we in this country are unaccustomed. The first tariff deals with 32 features of hazard in the city, the second with 80 features of hazard possible to the unoccupied buildings; and to each are added several features of special merit for which deductions may be allowed.

It would be impossible in a discursive paper like the present to discuss the cost price of risks class by class, and I now invite your consideration of some broad features of hazard which, like warp and weft, or, in geological phrase, like stratification and cleavage, cross the lines of the ordinary classification with which we are familiar.

Magnitude in Risk.

This element of hazard was to some extent recognised by the founders of our oldest Offices, who fixed their rates on an ascending scale according to the sums insured—thus, if the rate was 2s. per cent. for £1000, it was 2s. 6d. per cent. for £2000, and 3s. 6d. for £3000. In our modern tariffs we have, during recent years, made marked advance in the practice of charging for magnitude. In cotton mills and worsted mills we roughly measure size by the number of spindles; in warehouses, by cubical contents; in shops, clothing factories and boot factories, by the number of assistants or "hands"; in corn mills and oil mills, by the number of stones and rollers; in hosiery factories, by the number of sewing machines. Since the old factories and warehouses of extremely moderate size and height have given place to the colossal structures of our time this feature of magnitude has become one of considerable importance. Among other causes the operation of the Limited Liability Acts since 1862 has given an enormous impetus to the development of undertakings on a large scale. In the words of a recent trade journal, "the tendency of the present day is toward bigness in every department." The increased facilities of communication and transit afforded by the postal and telegraph system and steam power on land and sea have tended to a more rapid system of business, with corresponding increase of competition. Hence large stocks are not allowed to lie so long in hand as formerly; yet this is more than counterbalanced by augmented volume of business. We shall all agree that, to some extent, fire risk is increased with magnitude, a consideration long since enforced by Mr. James Robb in his paper on "Accumulation in Fire Risk." If it be a mill, each separate machine communicates its

risk, in some degree, to all the rest; if we have a hundred machines, to each of which a certain degree of hazard attaches, there are a hundred centres of fire risk. If, then, we extend the mill so as to accommodate double the number of such machines, the chances of an outbreak of fire are obviously increased; if, on the other hand, we could place our two hundred machines into as many little separate buildings, the risk of serious loss would be so reduced to a minimum that the manufacturer would quite properly deem insurance superfluous. Again, in large enclosed spaces there is free opportunity for the spread of flame and smoke, not to speak of water damage; each cubic foot of space passes on any mischief that it may contain to all the rest, while, with access of volume, the devouring element gains enormously in energy.

As against these considerations, however, we have to remember that extensive rooms for manufacturing or trade purposes are usually associated with methodical arrangement, strict management, vigilant oversight; that there are fewer dark corners and less overcrowding.

Intrinsic Value of Property.

Closely associated with the risk in magnitude is the risk in the relation of intrinsic value to bulk in the property insured; and along with this we may connect special susceptibility to damage from fire, smoke, or water. Here, again, we find that our pioneers had some idea of the principle involved, for notes, bills, china and glass wares, jewels, plate, pictures were among the items excluded from the protection of the policy. Many years ago the opinion was expressed by a distinguished expert that the rate for mansions ought to be many times higher than for cottages, and we all recognise the correctness of that view. In one of our palatial mansions, such as Chatsworth House or Eaton Hall, we have not only magnitude, but we have also our liability brought into a very compact compass by reason of excessive value, of the superior workmanship in structure and furnishing, and of the treasures of art there collected. The restoration of a single painted ceiling may involve outlay that would rebuild many cottages. An extensive warehouse full of raw material may be of equal value with a painting by Meissonier of a few inches square. Insuring both, it is not enough to estimate merely what is the risk of either the one or the other being attacked by fire, for in the one case you have many chances of the damage proving only slight and the salvage valuable, in the other case you have no chance at all

The principle involved in these extreme cases applies in less degree throughout the whole range of our business—to goods of delicate quality or high finish in comparison with heavy goods and raw material, to machinery that is either massive or cheap in comparison with such as may be of specially delicate construction or of great value. Even the high commercial reputation of your assured may be an element in estimating the cost price of his fire insurance. The miller who is overtaken by a slight fire in his granary will tell you that as a few sacks of flour are found to be tainted by smoke he must throw the entire stock of his best quality flour on your hands, because there is just so much possibility of it being affected that he shall not be able to allay the suspicion of his customers. The wine merchant cannot prove any distinct injury to his old ports, but he says they may have lost tone by the rise of temperature from a trivial fire which has occurred in his cellar, and their special value is depreciated, if not lost. The eminent firm of cutlers refuses either to refinish or to sanction the sale at auction of blades tarnished by water, because its world-wide reputation for producing only the very best quality of goods would be injured if anything short of the perfect article were to go out to the public bearing their name. Taking merchandise generally, there can be no doubt, however, that intrinsic value in proportion to bulk has materially diminished. The Board of Trade returns bear this out: thus, taking the imports, we have the following comparison:—

	Value.		Weight in Tons.		Increase °/o	
	1876.	1896.	1876.	1896.	Value.	Weight.
Grain, . .	£51,400,000	£52,500,000	£5,960,000	£9,760,000	2·1	63
Sugar, . .	19,500,000	18,200,000	890,000	1,540,000	-6·6	73
Meat, . .	18,100,000	35,100,000	330,000	860,000	93·9	160
Timber, . .	19,100,000	19,400,000	8,100,000	10,650,000	1·5	31
Cotton, . .	35,700,000	32,700,000	573,000	701,000	-8·4	22
Wool, . .	12,300,000	14,100,000	97,000	178,000	14·6	83
Flax and Jute, .	7,300,000	7,100,000	260,000	390,000	-2·7	50
Minerals, . .	11,100,000	18,900,000	1,530,000	6,540,000	70·2	327
Total, .	£174,500,000	£198,000,000	£17,740,000	£30,619,000	13·4	72·5

Considerable fluctuations have occurred in cost of building and of machinery. Thus, the outlay required to build and equip with machinery a fireproof cotton mill of 60,000 spindles would now be £90,000, as compared with £66,000 three years ago, or £110,000 twenty years ago. In fast-running machinery there is, of course, considerable depreciation in value as the years go by. The raw cotton at 6d. to 7d. per lb. twenty years ago would be 4d. to 5d. per lb. now.

Under-Insurance

is a too common feature of our business which materially affects the cost price of Fire Insurance. So long as under-insurance is uncontrolled we must expect to have selection exercised against the Office, therefore the rates cannot be fixed with correctness, and the assured cannot be treated with strict equity. The provisions of average, when applied to their full extent, may press rather hardly in certain cases, but it would be a great advance in the interests of justice if the principle of average were applied all round. Possibly it might even be found practicable to allow to the assured an option of, say, 60 per cent., 80 per cent., or full average, at rates graded accordingly; but this would involve certain difficulties.

Conflagration Risk,

in which is included the risk of excessive loss through catastrophes. In the light of the recent fires at Cripplegate, London, and Melbourne, it is not necessary to enlarge on the importance of this feature of our liability. It is, indeed, one of the most difficult elements of cost price with which the Fire manager has to deal. The proverbial difficulty of the problem where to draw the line is here emphasised, for no amount of experience will enable us to determine the course a conflagration may take, or where it may be stopped. Imperfect walls, common roofs, areas common to several buildings, narrow streets between lofty buildings, opposing windows, skylights, lanterns or other timber construction in roofs, gangways, mark the path for the fire. Frost, drought, direction and force of wind, explosion, inadequate water supply, paralysis of brigade arrangements, are powerful elements of extreme danger, which, either singly or in combination, may spoil our most clever estimates of liability. In many great commercial centres, but

especially in London, there exist to-day the conditions under which a conflagration of appalling extent is by no means impossible. If the fire in any of these congested blocks of high buildings should once get beyond control, all the elements of magnitude in risk come into force; the more hazardous building may be imperilled by the less hazardous, and all previous classification of the separate risks is merged in the one common hazard. Sydney need not claim the monopoly of the title recently applied to it by the chief of its fire brigade, "the city of dreadful blocks." Thanks to the admirable plans with which Mr. C. E. Goad has supplied us, we are now enabled to study the question of our liabilities in a more efficient manner than formerly was possible. It would appear to be the practice of most Offices to leave with branch managers the responsibility of regulating the larger limits over extensive blocks and congested districts in our great cities. This appears to me to be a matter in which the control of the Head Office would be appropriate, and in which its counsel should be sought, so that, with due regard to local features of risk, the policy of the Company at its different centres may be consistent.

Risk in Construction.

Our older buildings were, as a rule, strongly constructed of substantial materials. Oak beams, thickly plastered ceilings without openings, and the division into small rooms, were, so far, excellent checks on the spread of fire. Now we have changed all that, and our descendants will anathematise us for having adopted the system of jerry building under which the needs of posterity are ignored. Slight and faulty construction is heavily responsible for the cost of Fire Insurance; in our large cities probably one-third of the fires have their origin in structural defects, and it would be impossible to guess to what extent the magnitude of many fires is due to the same cause. The usual form of the old factory or warehouse is a narrow oblong, so that sufficient light was obtainable from the windows, small as they were, along the two sides. In order to secure greater accommodation for machinery and for stock the square form is now preferred; the windows are large and closely set, so that the masonry is often reduced to a minimum. As compensating features we have the improved height of rooms in our modern buildings, and the substitution of steam and hot water for the purposes of heating and drying in place of fire-heat

from open grates or brick flues, or from stoves with iron pipes; also, in some districts, the larger use of brick in preference to stone, though, as proved in the Cripplegate fire, bricks of poor quality are not to be relied on. In the case especially of warehouses, well-holes have become necessary for light and ventilation, and hoists for free communication; what tremendous effect these fire-flues have in accelerating the force of a fire, and in carrying it instantly from basement to roof, anyone who has once watched the effect will not forget. The typical Manchester area, between large warehouse blocks, and often having walls of timber and glass, offers great facility for the extension of fire. Linings of pitch pine to walls and ceilings in many of our warehouses and clothing factories is another modern element of hazard. The mansard roof, fortunately, has not found much favour in this country. The free use of iron girders and iron columns without any protection from the action of heat, and without due provision for expansion, is a serious modern feature, as tending to the collapse of the entire structure at the time of strain. Of this we have examples in the complete destruction of some of our large cotton mills of so-called fireproof construction—*i.e.*, having brick arched floors $4\frac{1}{2}$-in. thick, laid on exposed iron girders which are supported by iron columns. Various expedients for securing to buildings a semi-fireproof character have, from time to time, been devised, but none have been adopted to any extent. Even the modern jerry-built dwelling-house, with its light woodwork and defective hearthstones, is subject to hazards unknown in our old-fashioned houses. Mr. Thomas Potter, in a paper read before the Society of Arts on 26th ulto., advocates the fireproof construction of private dwellings at an estimated addition to cost of 15 per cent., but the popular demand of our time is for cheapness.

Moral Risk

is an element of cost price which cannot be assessed by any rule. In times of adversity the temptation to sell to the Insurance Company must press heavily upon the manufacturer or trader who is not restrained by any sense of principle. And it is not necessary to heap up shavings, to pour on petroleum, and to apply the match. A little judicious laxity in management, a little neglect as to lubrication of machinery or removal of waste, may suffice, so that the mill may fire itself; and a sensitive

conscience that would recoil at the former process might not be greatly strained by adopting the latter. Still, I do not share the common notion that increase of fires invariably follows bad trade and adverse markets. It would be easy to quote many cases to the contrary. The most important cotton-spinning district in Lancashire has experienced singular immunity from fires in times of great depression. One trembles to think how many manufacturers in England to-day would regard the burning down of their well-insured mills containing old machinery as a piece of rare good fortune. The times of mill-burning by riotous workpeople are happily past. If we except the disgraceful occurrences in the Hull timber yards during the riotous proceedings there in 1893, we have long been exempt from this malign influence. This, at least, may be said of our modern working classes, that under the strain of such prolonged conflict as we have lately seen, they do themselves great honour by the restraint and moderation of their conduct. Probably more fires than we suspect are the result of theft, personal spite, and illicit lodging.

In a paper like the present it would be impossible to refer in detail to all the elements of hazard which run athwart our ordinary classification of risks, influencing more or less the cost price in every one of these classes. We have yet to determine the relative cost price of insurance of buildings and of their contents in the various classes, the cost price of multiple tenancy, of night work, of chemical action, of friction. In the manufactures the free introduction of adulterants and low-class materials in order to cheapen products has had its marked effect on the fire risk. We now have shoddy and cotton as staple materials in most of our woollen mills, celluloid in place of ivory in our cutlery works, paraffin in our soap works, residual products in our gas works, bi-sulphide of carbon and "rubber substitute" in our rubber works, esparto grass and the lowest qualities of waste in our paper mills —though be it said in this last instance we have an important set-off in the recent introduction of wood-pulp. There are new and hazardous processes, as in corn-milling, cotton and velvetine finishing, aniline black dying; new trades, as in the manufacture by power of lace, clothing, boots, bicycles, electrical apparatus, waterproof clothing; new methods of storage, as with corn and petroleum; new features of risk, as in the unlimited use

of lucifer matches and of mineral burning oils, flaming at the dangerously low temperature of 63° Fahr.; of badly-insulated electric-light installations.

As yet we have no complete yearly record of fires in the United Kingdom, and a vast amount of valuable experience is therefore lost. So far as the provinces are concerned, the Federated Institutes would be well able, with the co-operation of the assessors, to undertake the compilation of such a record year by year. It would have to be so prepared as to be adapted to classification and analysis in various ways; it should supply the most accurate information available as to the origin of each fire, especially as to the precise locality of the outbreak with reference to processes, goods stored, structural features, and stoves; as to the hour, etc. But no such undertaking as this could ever be attempted until the full approval of the managers of our Companies had first been obtained.

I have thus endeavoured to suggest, in a manner necessarily most superficial, some aspects of the question of cost price in Fire Insurance. We cannot but be impressed by the great variety and complexity of considerations more or less subtle and undefined, if not undefinable, which go to the making of a scientific "pure premium" in Fire Insurance. My aim in attempting the review of so wide a subject is to assist the younger Insurance officials present—upon whom some day the responsible conduct of the business may devolve—to perceive how wide and how interesting are the aspects of this many-sided business of ours, what scope it affords for research and observation, for the balancing of various considerations, for the combination of judgment and experience, what encouragement it offers to intelligent application. By much patient effort the business has been brought thus far upon sound principles; to the rising generation of Insurance leaders will belong the honour of still further developing the principles of equity in assessing the cost price of Fire Insurance.

JAMES OSTLER.

Insurance Institute of Bristol,
February, 1898.

SHIPBUILDING AND MARINE ENGINEERING.

Like unto ships far off at sea,
Outward or homeward bound, are we.—*Longfellow.*

SHORTLY after being honoured by the request of your Executive Committee to prepare a Fire Insurance paper upon this subject, my thoughts became concentrated upon the particular features of the Underwriters' knowledge of the industry, and I was greatly concerned as to where my remarks should begin.

In turning this over in mind, I questioned an old friend, but his reply was far from encouraging, although highly flavoured with the rhetorical condiments which are mostly acceptable to a University Debating Society. "The Phœnicians and Egyptians were the earliest navigators," he commenced, and then, continuing, went on to say that "mankind very probably first floated on logs—the raft composed of logs bound together would most likely follow—then a log would be hollowed out, and wickerwork coracles covered with skins were used. Homer describes Ulysses building a raft having a raised platform. Steamboats were constructed in 1788, attaining the speed of four to five miles an hour, and," he went on to say, "it is within my recollection that it was from the works of John Neilson (Oakbank Boiler Works) that the first iron steamer was floated into the Clyde. The works were in the Cowcaddens, and the vessel when completed was hauled down Renfield Street and launched at the Broomielaw."

But don't imagine that I am going to start our literary excursion this evening where my friend left off (the Broomielaw). Like many other innocent citizens, I did once venture to start thence upon an excursion to view the shipyards of the Clyde, but it was low tide, and I found reason to avoid that route since, whenever bent in that direction. I thanked my friend for his interesting

remarks, little thinking, however, that eventually they would launch me upon the subject.

And now being fairly afloat, I find myself confronted with many diverging channels, but I will make back again to the launching ways after a short review of my subject, and ultimately take you metaphorically with me to the scene of the

Clang and the bang and the ding, ding, dong.

The Thames was once a great shipbuilding river, but the trade has now largely departed to where iron and coal are closer at hand. The Thames, however, has yet the reputation—by way of survival—of building more vessels of wood and sailing vessels than any other centre, but they are all small craft, and only average about 53 tons. With one or two exceptions, it is literally a barge-building river. Without giving undue prominence to the importance of the industry at our own doors, for comparative purposes it will be interesting to give you the recently published returns for the British, Colonial, and Foreign Shipbuilding, viz.:—

SHIPBUILDING (1899).

	Sail.		Steam.		Total.
	Vessels.	Tons.	Vessels.	Tons.	Tons.
Clyde	41	14,618	243	476,456	491,074
Forth	2	880	28	14,762	15,642
Tay	—	—	19	17,908	17,908
Dee	—	—	28	11,973	11,973
Dockyards	—	—	7	69,100	69,100
Tyne	1	794	118	290,499	291,293
Wear	—	—	75	268,508	268,508
Tees	1	50	53	148,020	148,070
Hartlepool	—	—	40	134,099	134,099
Humber	44	6,280	113	26,007	32,287
Mersey	26	2,758	16	10,826	13,584
Thames	117	16,110	21	5,095	21,205
Other ports	67	4,995	47	61,892	66,887
Ireland	4	600	17	131,123	131,723
	303	47,085	825	1,666,268	1,713,353
Foreign and Colonial	113	80,053	383	600,220	680,272
	416	127,137	1,208	2,266,488	2,393,625

MARINE ENGINEERING (1899).

	L.H.P.
Clyde	478,503
Forth	15,556
Tay	22,030
Dee	12,310
Tyne	284,079
Wear	139,119
Tees	85,200
Hartlepool	45,000
Humber	35,000
Mersey	35,000
Barrow	34,500
Thames	90,000
Belfast	96,280
Other ports	25,000
	1,397,577

It might be incidentally mentioned that at one Clyde yard the sum of about £500,000 is distributed annually amongst about 7000 employees, and its completed annual output represents a value of over £1,500,000. This, no doubt, is very much exceeded in other quarters, and I read that the wages bill at the Royal Gun Factories reaches about £26,000 per week.

The ramifications of the industry are too numerous for me to attempt to detail or even mention, but having referred to armament, I feel compelled to make at least a passing reference to the allied trades, which include the manufacture of armour plates, ship plates, and shafting. Indeed, it is peculiar that I should have to isolate these, for it came to my knowledge recently that at one large work the entire range of operations from the raising and smelting of ironstone to the complete equipment of iron or steel ships were carried on practically within its boundary walls.

The terms *Ship*, *Vessel*, or *Craft* are applicable to any navigable structure of wood, iron, or steel specially contrived for traversing seas, channels, rivers, etc., or to be moored in such waters for particular services—*e.g.*, lightship; and although the term "Ship" is thus applied indiscriminately to craft of any kind, it is also commonly used to denote a sea-going vessel of considerable size, and in its stricter meaning refers to a full-rigged one. The rigs of steamers differ from those of sailing vessels only in so far that the masts and spars of the former are usually much lighter than those of the sailing ship. But I must not be drawn too far in this direction, for the terms given the various hulls, etc., are so numerous that it would require a whole volume to convey any adequate idea of the craft.

The merchant ship or vessel differs in many particulars principally as concerns—(*a*) the material, whether wood, iron, or steel; (*b*) the type; (*c*) the mode of propulsion; and (*d*) the rig.

Wooden Vessels,

chiefly sailing ships, now rarely built as sea-going steamers, have all the principal portions of the hull—such as keel, stem, sternpost, frames, beams, inside and outside planking—of wood. They are also of two kinds, those of hard wood and those of soft wood. The bottoms are sheathed with yellow metal and sometimes with zinc to prevent "fouling" and "worm eating."

The Composite Vessel

is built of iron and wood. The keel, stem, sternpost, and planking are of wood, and the frames, beams, keelsons, etc., of iron. This class of craft as cargo vessel is rather expensive, and now seldom constructed.

Iron and Steel Vessels.

It is recorded that the first iron vessel erected on the Thames was built in 1836, but it was not until 1845 that they became general, and year by year they began to rapidly supersede the others until about 1884, when steel was introduced.

The wood and composite period came to an end, and planking gave place to plating; but machine tools were few and primitive, and British builders were slow to move. America went conspicuously ahead about 1860, until we took to their methods and went beyond them on lines which gave us the famous "Tea Clippers," and eventually supremacy triumphed in the production of that complicated box of machinery, the steam vessel of to-day.

The many kinds of material seemingly well adapted for the uses to which they are put have yet apparently a doubtful side to their otherwise good qualities, and steel forms no exception. It remains for the future to determine whether steel will be supplanted for shipbuilding to the extent that iron has already displaced the use of wood.

Let me now endeavour to define the following comprehensive terms:—

Hull,

which comprises the keel, stem, sternpost, propeller post (if any), keelsons, stringers, beams, decks, inside and outside planking or plating, frames, poops, forecastle, etc., but excludes equipment.

Machinery,

as applied to steamers, includes all mechanical appliances for the propulsion of a vessel and for auxiliary purposes, boilers, and engines.

Equipment.

All the appliances and installations necessary for propelling a vessel, such as masts, spars, sails, rigging, etc. (also the machinery of steamers before described), anchor and apparatus, including chain cable, and anything tending to ensure the safety of the ship, her crew, passengers, and cargo, such as boats, pumps and their gearing, etc.

The various factors in the great developments in steamships are: —The use of high-pressure steam with compound, triple-expansion, and quadruple-expansion engines; the use of steel instead of iron, rendering the parts stronger and lighter; the use of surface condensers, which quickly reduce the steam to hot water ready for the boilers; and the improvements in boilers, including water-tube boilers to raise steam quickly, continuously, and at a high pressure; also the improvement in the shape of the vessel, which enables her to carry increased cargo and make quicker voyages.

In shipbuilding we have two branches—the scientific and the constructive. The first is displayed in the designing and laying down the plans for the desired fabric, the second in the mechanical skill exhibited in putting together and properly fastening the numerous parts required to complete a vessel.

With regard to the scientific department I have nothing to say, and the constructive features will be only dealt with so far as the trained Fire Insurance Surveyor's observations and experience go, without any redundant theory or mathematical demonstration.

In surveying, "two elements come into play, which belong "respectively to the world of sense and to the world of thought. "We observe a fact and seek to refer it to its laws; we "apprehend the law and seek to make it good in fact—the one is "theory and the other is experience."

My description of shipbuilding will be confined to the iron or steel vessels which, as you will have gathered from my previous remarks, are now almost universally predominant.

The ship is begun with a complete drawing. In the case of warships the plans are made by the Admiralty, and draughtsmen are sent to Whitehall to make tracings for the builders invited to contract. These drawings are enlarged to the full size of the vessel's outward form upon the mould loft floor, which is practically a huge drawing board. Every line needed in building the vessel is here laid down, and from these lines moulds or templates, made of thin flat boards, are taken.

The templates are transferred to the scrive board (a solid floor of wood), and there the lines are incised, so that error or erasure is not possible. The shipwrights' mechanical work then commences. Near the furnace for heating the angle-iron for the frame or ribs of the vessel are "bending blocks"—a pavement of square slabs of iron forming a level floor perforated with holes about six inches apart in parallel lines. The pattern of one of the frames given on the scrive board is placed upon this floor, and a peg is put into every hole the curve touches. Red hot angle-iron is drawn from the furnace and thrown upou the slab, where it is laid flat, pressed against the pegs, then levered or hammered where necessary, until the desired curve is obtained. The corresponding rib is formed against the pegs in the same way, so that the two must be alike, and every curve is proved on the scrive board to ensure its correctness. The ship-plating requires different treatment, and for these plates machinery of various descriptions is employed, and, whether the plates are required flat or curved, there are ingenious contrivances to manipulate the smallest or largest and heaviest of them.

Perhaps it would be interesting to describe at this juncture the making of armour plate, although this and the making of ship plates are not carried on in the shipyard. A mould is made for every armour slab. The steel alloy is melted in the furnaces in sufficient quantity to allow of all the unsound portions being cut away; the ingot as cast being thus much larger than the finished plate. When taken from the casting mould it is reheated, and forged, not by hammers, but by a hydraulic press of some thousand tons pressure. From the press the plate goes to a rolling mill, where it is rolled down in one heat, afterwards roughly cut out to size, and then placed in a carburising furnace for about

a fortnight. When removed from this furnace it is again heated, and bent into shape by hydraulic pressure. The last stage is the hardening, which is effected by again heating the plate, and spraying on both the surfaces an equal and continuous flow of water until perfectly cold. Finally it is compared with the mould, and erected and tested with the adjoining plates it has to fit, and if anything has gone wrong under the process, so hard has the plate become that it has to be melted down, and undergo the whole processes again. To again roll or even cut it up for smaller plates is simply impossible. It will, therefore, be understood, that any reference to the machine work for *plates* does not refer to *armour plates.*

THE BUILDINGS, THEIR OCCUPATION AND FEATURES.
ADMINISTRATIVE DEPARTMENT.

The buildings in this case may be under one roof or situated in different places about the yard. They comprise the counting-house, general offices, private rooms, drawing offices, model room and model-makers' workshop, photographic rooms, waiting and commercial rooms with gatehouse and weigh office, tracing rooms, and offices for Government overseers and inspectors employed by the clientèle having ships in course of construction.

In passing through these buildings, we are probably struck with the array of draughtsmen. The drawings, we are told, are stored in strong rooms, and the labour bestowed upon them represents a large value. Then there is the model-maker and his work. Some of the models are mere relics that have formed attractive features of the expositions of the world. All, indeed, works of art, and exhibitive of skill and patience. These models of ships are made with great minuteness of detail, extreme neatness, and are, therefore, very costly. The photography rooms and the method of printing, whether by sun or electricity, and the chemicals used, will claim attention.

At one well-known shipyard there is an experimental tank, measuring about 300 by 23 feet and 12 feet deep, in which models are tested. These models are made of wax. A rough shape constructed of timber laths and calico forms the core, and is placed inside a clay mould; melted paraffin wax is then run into the mould and allowed to cool. The moulded wax is afterwards trimmed and shaped mechanically to scale by a valuable machine (Froude's patent)--a most wonderful automatic mathematical instrument.

The General Store

will not be far away from the administrative block, and regard will be paid to the quantity and character of hazardous goods kept, such as oils, paints, varnish, cleaning waste, &c.

The Moulding Loft.

As the term "loft" indicates, this room is generally the highest floor, and in the most extensive building, great floor space being required for "laying off" the plans to the full size, as previously explained. This floor, as also the scrive board, is sometimes blackened, and it is essential that the lampblack used for the purpose should be safely stored. Wood templates are made here.

Steel and Iron Workers' Sheds.

These sheds are immediately in proximity to the shipbuilding berths, and generally contiguous to railway sidings, where the angles and plates are discharged and stored. They have often earthen floors and more or less open sides, and here will be found the scrive board and blocks, boilers for generating steam, furnaces for heating bars, angles, and plates, others for annealing and forging, smiths' fires, and machinery of the heaviest kind for planing, bending, punching, shearing, drilling, counter-sinking, plate levelling, bar straightening, &c.

The furnaces are either heated by coal, gas, or oil fuel; the "Gorman" type are heated by coal gas, generated by apparatus sometimes in close proximity to the furnaces, often outside. Gas fuel, I understand, heats in half the time, at half the cost of coal fuel. When oil is used as fuel, the bulk is stored generally in metal tanks outside. It is a crude or cresote oil, the same as used for lucigen lamps, conveyed by gravitation pipes, and at the point of entering the furnace is met with a blast of steam, which aids the combustion. The gas and oil fuel furnaces are started by igniting greasy waste.

Many of the machines are fitted with separate steam-engine, pumps, accumulator, and hydraulic crane.

It is not to be imagined that these sheds are in every case under one continuous roof. I have merely chosen to refer to them collectively, for the reason that in different localities they are known by different names, and comprise the following:—

(1) The Platers' Mill or Machine Shed.
(2) The Bar Mill or Angle-Iron Shed or Frame-Benders' Shed.
(3) The Blacksmiths' Shop.

The Saw Mill and Joinery.

In this building will be found almost every machine made for working in wood; benches for joiners, cabinetmakers, pattern-makers, and polishers.

A passing reference, perhaps, is only necessary to this very important and most hazardous of buildings, in view of a separate treatise on wood-working risks in connection with the Society's publications.

It is obviously desirable that this great accumulation of fire hazard should be divided, and more than *one* building provided for the accommodation of the trades, particularly where there is a large amount of work done.

Pattern-Makers.

This trade is understood to embrace the making of all kinds of wood patterns for iron and brass foundry or steel casting work. Sometimes metal and stucco patterns are made. A pattern is made for each part, and a set of patterns includes the whole of the patterns which go to make up the complete castings for any one engine or machine. The perfection of the casting depends very much on the skill of the pattern-maker. The woods used are alder and pine, and sometimes mahogany.

Although these patterns are invariably made and stored on the shipbuilder's premises, the work of casting from them is often performed at other places.

Where patterns are stored, particular care should be taken as to broken windows, the use of naked portable lights, &c., and the patterns should always be kept orderly—numbered and scheduled—if for no other reason than to avoid the danger of rummaging with movable lights.

Drying Stoves.

The drying of timber always forms an important feature about a shipyard. Wood requires two years at least natural seasoning for carpentry work, and four years for joinery work.

It will thus be apparent that both time and money are saved by the various methods of artificial drying or dessication. The most rapid and at the same time satisfactory method of drying timber is that known as the "common-sense" principle. The timber is piled with an air space intervening between each layer in the fireproof stove, which is heated by ranges of steam pipes fixed against the sides. The moist atmosphere is extracted, condensed, and hot air returned to the stove by means of an outside engine and apparatus. When the condenser ceases to discharge liquid the process is complete.

The hydraulic engine and accumulator houses, workshops for plumbers, coppersmiths, and painters, brass moulders and finishers, boatbuilders and riggers, will all find a place for comment in an exhaustive survey.

Engine Shop.

The principal building of the marine engineering section. Here the various kinds of engines (simple or compound), shafting, cranks and crank shafts, bed plates, columns, guides aud framing, condensers, pumps, valves and valve gear, propellers, cocks and valves, machinery for starting and reversing engines, &c., are made, and all castings, forgings, and metal of many kinds are wrought.

The processes may be described as consisting of finishing, fitting, or erecting—all relating to the "cutting away of surplus "material, thus giving accurate dimensions to the parts of "machinery that come in contact with each other, and are joined "together, or move upon each other."

All the work done is performed at the normal temperature of the metal, with little exception, and machinery for turning, boring, drilling, planing, &c., is employed, including some of the largest machine tools in existence. Overhead travelling cranes, derrick cranes, and hydraulic cranes are used.

Many parts of the marine engine, formerly made of forged iron, are now made with advantage of cast steel, and it is likely, we are told, that steel will supersede many of the cast-iron parts.

The features of hazard in this building very often embody pattern-making, store places for hazardous sundries, such as lamps and lamp oil and lubricating oil; and sometimes wood patterns are crowded in lofts. The numerous fires originating in these portions are in themselves sufficient warning that they are

features which should be eliminated. In buildings of more than one storey there is often a main upright shaft, and the bevel wheels, as well as the shaft, will occasionally—perhaps I should say invariably—be found encased in wood; a most dangerous feature. Metal casing should be substituted.

The Boiler Shop.

The boilers for generating steam are erected here. The economy of fuel is of the greatest importance, and many improvements have been effected towards this end. Perhaps the most outstanding type of boiler now made is the water-tube boiler, of which the leading patterns are the "Babcock and Wilcox," the "Thorneycroft," and the "Belleville." The last-named has been for many years most favourably regarded in other countries, but did not gain recognition here until it was at length adopted by the Admiralty. It is now largely used for large ships.

Smiths' and riveters' fires, plate and forging furnaces, are the prominent features in these buildings, and the machinery includes hydraulic flanging, riveting and staving machines, plate-bending rollers, overhead cranes, &c., including machines for the lighter work of boiler mountings, uptakes, funnels, &c.

Should there be an iron foundry on the premises the core stoves will be noted, as also the safe storage of dust or blacking, consisting of powdered charcoal and finely ground coal and coke dust, and the use of paraffin oil for preventing the rusting of castings.

The character of the seating or foundations of steam engines and heavy machinery will be carefully noted in all or any of these buildings. Many of the metal-working portions have earthen or solid wood floors, but very often loose boarding is carried contiguous to the base of greasy machinery, and the seating, foundation, or flooring are very often fuel for the entire destruction of this costly and otherwise fair salvage property.

Heating, Lighting, and Power.

The various methods for heating, lighting, and power require special attention in all the buildings.

Naphtha, oil, gas, and electricity for *lighting;* steam, gas, oil, air, water, and electricity for *power;* and steam and other modes of *heating* all take their respective places with regard to the danger to be apprehended.

Heat is communicated from one body to another in three ways:—

(*a*) By direct contact, called *conduction.*
(*b*) By right lines, called *radiation.*
(*c*) By carrying, called *convection.*

The loss of heat by radiation from service steam pipes is a matter of great importance. Seaton, in his book on *Engineering* (p. 450), says:—"The material used to avoid this, besides being "a non-conductor of heat, should be incombustible and inorganic. "Hair felt is a good non-conductor, *but it is very liable to take "fire.*"

Whilst the scientists of this industry have always paid marked attention to the danger of fire to be apprehended in the floating palaces, it has always struck me as being most remarkable that the attention to ordinary common-sense principles of safety for buildings on land is so neglected. This inattention, in some instances, is positively verging on criminal neglect.

Building Berths and Open Yards.

(Ships Building, Finishing, and Repairing.)

Turning now to the building slips and launching ways. Amid the maze of bars, girders, scaffolding, shoring, and scantling, the shape of a ship may be discerned resting upon the blocks. Here the ribs of a warship, there the plated frame or shell of a merchant vessel. The time occupied in the construction of a vessel, say of 8500 tons gross register, is within twelve months.

The respective hazards of the various types of ships in course of construction should not be overlooked. There are special features in war vessels connected with the "armour, shell-plating, double bottoms, gun galleries, moulds, and other considerations," and it will be rightly surmised that in composite and sheathed vessels there are peculiar features that do not enter into iron or steel merchant vessels.

Asphalte or asphaltum, a bituminous waterproof substance, is sometimes employed instead of cement for covering the inner surface of a ship's bottom. But this natural product should not be confounded with the artificial combination of gas tar, pitch, and sand so commonly used for making footpaths.

Then there are the materials for the caulkers' important trade. The use of tar (coal tar from coals, Stockholm and Archangel tar from pine wood) for ropes, tarpaulins, &c.; pitch, which is tar boiled down, for covering oakum in the caulked seams; and tallow

for lubricating purposes. The heating or melting of tar, pitch, or tallow, and the storage of them, will be observed; and also the use and storage of anti-fouling paints or compositions. This anti-fouling preparation is used for protecting that part of the vessel below the water-line against corrosion and incrustation, and it is largely made up of naphtha. Metallic oxide is the secret of its protective qualities.

The stock of timber, patterns, lumber, and trade materials in the open yards, as also the palings or fencing, very often forming items of insurance to a large sum, will next be of interest, and the hazardous surroundings or contiguity will be noted.

Workers Generally Employed about a Shipyard.

1. The Steel or Iron Workers' Section,

perhaps the most important as involving the bulk of the wages, is composed of several branches, viz.:—

(*a*) *Platers and Fitters*, who set the framework to the lines taken from the moulding loft, and mark, punch, shear, or plane the plates for floors, double bottom, stringers, decks, bulkheads, shell plating, casings, and all structural work, and fit same in place bolted up ready for the riveters.

(*b*) *Riveters* (in squads generally comprising two riveters, a holder-on, and a boy) follow the platers, and close up the work left in position by the platers.

(*c*) *Drillers* bore any odd holes which either cannot be punched or are usually left to be drilled for more accurate work, such as beam knees, and holes for the bolts by which wood is secured to iron decking.

(*d*) *Caulkers* make the seams of the steel or iron work water-tight by caulking—*e.g.*, in the shell, bulkheads, &c. The caulkers also cut any openings which have to be done after the work is in place, and could not be punched out by the platers, for example:—The windows in deck-houses, which are marked off after the houses are built; holes in decks and bulkheads for the passage of pipes, &c.; and tap holes required to be tapped instead of riveted, and fair all edges by chipping or paring.

(e) *Angle Smiths* do the welding of angle bars when required, as staple for engine seats, watertight collars for frames of watertight flats, box-ended knees, &c.

Note.—Fitter-helpers are employed by platers to assist them generally, and *strikers* by the angle smiths. These are really labourers, who, by being employed on the same work for a time, have become proficient, but not having served an apprenticeship, can only assist.

2. Blacksmiths

make pillars for beams, boat davits, anchor cranes or davits, awning stanchions, gunwale rails and stanchions, mast and derrick fittings and cargo gear, and generally do all smithwork throughout.

3. Mechanics or Engineers

finish all smithwork, drill holes in castings, fit rollers to fair-leads, make watertight doors, sluice valves, &c., fit such gearing to all these as is required, bush and line gudgeons on sternpost and pintles on rudder, fit steering gear connections, also winches and deck machinery, and generally do all the steam service and engineers' work in connection with the hull (as apart from the propelling machinery).

Note.—This trade comes into contact with the plumbers in the fitting of iron pipes for water service, fire service, &c.

4. Brass Moulders and Brass Finishers

make and finish all brass or composite metal-work, such as side-lights, valves, &c., and supply all metal fittings for carpenters, joiners, mechanics, plumbers, &c.

5. Coppersmiths

do the bending, flanging, and fitting of all copper pipes for steam to winches, windlass, &c.

6. Plumbers

do the pumping and draining systems generally, and fit up service and waste pipes of baths and lavatory arrangements; fit lead sheeting where required, and complete the water service of hull generally. They also make copper buoyancy tanks for lifeboats.

7. Carpenters.

The carpenters lay blocks at the proper declivity ready for the commencement of the vessel; place all staging, shoring, ribboning, &c.; lay the ways under the ship, and do the work of launching; lay and fasten decks and caulk same; fit ceiling and sparring in holds; make and fit hatches; and do all the heavier woodwork, and woodwork that has to be caulked.

They also erect the frames in their proper position fore and aft, vertically, athwart ship, and horizontally; keep the body of the ship fair whilst platers are proceeding; and until the work is fixed by being riveted, do all lining-off for the landings of the shell, &c., and the insulation of refrigerating spaces for cargo (but not for stores).

Note.—It is sometimes rather difficult to define, or at least readily understand, the line of demarcation between this trade and the joiner's trade.

8. Joiners

fit up all the cabins, fit lining to ship's sides in the way and on under side of decks as required, make all wood deck-houses, skylights, ladders, companions, &c., staircases, entrances, wash stands, chests of drawers, &c., and fix them in place. They also fix berths, whether of iron or wood, and all mountings.

The joiners fit up the insulation of refrigerating spaces to be used solely for provisions or stores, and in many cases make and fit up the polished hardwood framing and panelling of the dining-saloon, smoking-room, &c., more especially where this is fitted solid (*i.e.*, not veneered).

9. Cabinet-Makers

make all the finer woodwork for the public rooms, such as framing and panelling—veneered, or of special design involving the use of fancy woods, inlay work, carving, &c. They also make all special furniture, as bookcases, sideboards, &c.

10. Pattern-Makers

make all patterns for castings, such as stern frames, brackets, deck bollards, fair-leads, &c.

11. Polishers

work in conjunction with the joiners and cabinet-makers, and french-polish all the framing or fittings which require to be so treated.

12. Painters

carry out all painting, varnishing, gilding, and decorating generally.

13. Cementers

do all Portland cementing in the bottom of the ship and in waterways or chocks, lay tiles in galleys, &c.

14. Boatbuilders

make and fit all small boats complete.

15. Riggers

do all the rigging and erect ship masts, derricks, &c., ship boats, also do all the heavy lifting required about the yard, transport heavy castings or forgings (such as sternposts, &c.), and put them in place, and attend to deck work generally at launches and trial trips; moor and shift ships for fitting out.

There are, of course, a considerable number of "helpers" or "labourers" in some of the trades who are practically men "assisting but not qualified to learn the trade."

Besides the foregoing there are what are known as outside contractors, for example, electricians, lamp makers, sail makers, galvanizers, anchor and cable makers, upholsterers, makers of cooking apparatus and of nautical instruments, sundry outfitters, &c., &c., all or any of which may or may not be employed at a shipyard.

Fire Risk and Fire Prevention.

Safety is very often estimated in our minds by the degree of hazard attaching to the process or the character of the goods stored; and whilst this feature is the only basis upon which the assessment of a normal rate can be made, the real safety depends vastly more upon order, cleanliness, discipline, and extinguishing appliances.

The prevention of fires is undoubtedly in a greater measure in the hands of the works management than they at present know of. A keen interest in and an intelligent knowledge of the requirements of the Fire Offices constitute the chief guarantees of immunity from fire. "A place for everything and everything in its place" is the ruling motto in this respect.

There must be something particularly gratifying to the practical Underwriter when he finds the Surveyor's notes on these essential points are favourable; but it is urprising the varying degrees of order and cleanliness which we are asked to believe are all the acme of perfection. The Insurance Companies' periodical visits of inspection cannot cope with the constantly changing features of hazards in works of this kind; and a firm of standing will appoint to on of their staff the duties of Inspector, a trained fireman preferable, and attention will be given by him to the following:—

INSTRUCTIONS.

1. No drying of any kind to be done on or near the boilers, furnaces, or stoves, and these to be clear of combustible material, and the smoke and flue connections to be kept tight. Damper holes, particularly, should be exposed to sight.

2. Vents to be free of inflammable dirt and clear of roof woodwork, and air casing should be provided; where vents are carried outside they should be taken high above the level of the eaves.

3. Steam or hot pipes throughout their whole length, including all concealed spaces, to be free from contact with wood, waste, dust, or splinter wood and other combustible material.

4. Spaces beneath work benches and tables to be clear of accumulation.

5. The open yards where wood, patterns, and lumber are stored to be kept clear of shavings, rubbish, or other waste accumulation. The safe deposit of ashes from the fireholes is to be particularly required.

The duties of this Inspector would also include that he report weekly upon the result of these examinations and observations, as also on the heating and lighting arrangements generally, the safe storage of oils, varnish, and inflammable sundries, and the conditions of fireproof doors.

Sawdust, some will say, will not burn. Yet I have had experience of how a spark will worm itself instantly into the heap of

sawdust, and, unobserved, set up combustion in the very heart of it. When the sawdust heap commences to smoke or to smell of fire, it may be days after, the only successful way to tackle it is by drenching it with water, commencing at the fringe. To open up the heap would mean the bursting of it into flame, and the rapid spread of fire. Sawdust and chlorate of soda would burst into flame at once if a drop of sulphuric acid were to touch the mixture, and many other combinations of salts and sawdust give similar results. Sawdust impregnated with a very little animal or vegetable oil or grease is considered a certain incendiary. The accumulation of sawdust refuse must therefore be avoided, and its use as an absorbent for oil drippings and water is to be condemned.

Sulphuric and other acids will be met with occasionally for cleaning greasy metals, and therefore it is necessary that filings, chippings, or turnings should not be deposited on the floor or in the buildings unless in metal receptacles, and that these, along with all waste, be cleared outside daily.

Edward Atkinson, the president of the Boston Manufacturers' Mutual Insurance Company, said in one of his addresses—"All "steam pipes should be kept from contact with wood, as such "contact is the frequent cause of fire. Anyone who denies this "is an ignoramus."

The safest method of heating is to hang the steam pipes overhead—this system also ensures more free floor space. Friction through bad lubrication is the cause of many fires, as the "over heated journal" of the assessors' reports testifies.

The fatal "spark," "dropped light," "surreptitiously smoking," "workmen leaving lighted pipe in coat pocket," and the many other causes of fires can all be guarded against by careful management.

A practical insight into chemistry as affecting engineering is now considered essential for the complete education of an engineer, and whilst the analysis of metals, materials, and water for boilers, the testing of oils for safe lubrication (for the best is the safest), the quality or calorific and evaporating powers of solid, liquid, and gaseous fuels with a view to economic application resulting in complete combustion and the minimum of heat wasted in the flues, have all an indirect bearing upon the prevention of accidental firing, it is to be hoped that this knowledge of chemistry will be extended in its direct relation to fire risks and fire prevention.

FIRE EXTINCTION.

The magnitude and importance of a concern generally has a very important bearing upon the organisation of an adequate system for the extinction of fires. It is not too much, however, to expect as a matter of self-respect a suitable service for coping with fires in the smaller establishments.

Automatic sprinklers are being extensively introduced into risks of this kind. It is not necessary for me to allude to this admirable apparatus further than to record that the numerous experimental tests by which the Fire Offices and the public were first convinced of their value are now superseded by the practical experience which has established their efficiency during the length of time since they were first adopted.

The more extensive risks are possessed of not only an equipment of automatic sprinklers, but also a complete service of water pipes and fire plugs throughout the premises, with water supply from town's main and/or other sources, stationary fire pump, brigade portable steam fire engine, hose sufficient to command all the premises, extincteurs and fire buckets throughout the buildings, and a works brigade drilled and instructed by a trained fireman.

The duty of this fireman also includes keeping the fire-extinguishing appliances in proper order, and as he would have the privilege of entry to all parts he would be required to report upon the fire hazard as previously detailed.

To render the service more prompt and efficient in case of fire, electric alarms are fitted throughout, and upon the sounding of an alarm each man (the brigade embodying the most intelligent of the workers) will proceed to his appointed place and await orders.

With such an arrangement it is easy to imagine that the man in charge will not have to bawl and halloo to a crazy crowd who work hard and do nothing in the case of many fires.

I remember when, at one yard, I made my enquiries as to what means they possessed for tackling a fire, the manager exclaimed, "Why, bless you, our men are all born firemen. One of them recently 'listed in the army, and when going through his recruit drill left the ranks to look for the hose when the command was given to 'Fire'!"

There was food for reflection in this, but the humour of the intended convincing remark was lost in my subsequent careful

investigation, which proved that the hose was rotten to holes, the extincteurs were dry and rusty, and the plugs?—well, were "somewhere about," and I thought the dilemma of his men would be as bad as that of the recruit in the event of a call of "Fire."

In favourable contrast to this, I must tell you that in at least one yard, to my knowledge, there is a fire inspector such as I have previously referred to, the fire-extinguishing apparatus comprises all the favourable arrangements suggested in my remarks, notwithstanding that one of the finest public fire brigades in the kingdom is within easy call.

Rates.

The "Ships Tariff" applies to ships building, finishing, or repairing, and/or in harbour, and steam vessels plying in the United Kingdom, but, influenced by considerations of which we are well aware, the shipbuilders have within recent years extensively protected themselves with policies from "Lloyd's" or other marine insurance corporations. For a rate little more than charged by our tariff, they get all material covered not only in the hull itself, but also in any of the shops where the work is in progress.

Our tariff system has often been compared by the Insured to a huge trade-unionism. It will be apparent to you gentlemen that if *we* had thought so there would have been a "strike" against this encroachment by the other "squad."

Cheap insurance has been compared to "saving time by stopping the clock." It was my intention to give you some commentary upon the rating of the different buildings, but I cannot stop the clock. None of us have all the qualities of perfect underwriters, but some of us don't know it.

"That some good risks may be written at any rate, and that any bad risk may be written at some rate," are not first-rate insurance ideas. There is a difference between risks that possibly may burn and those that possibly may not.

Policies.

My attention has been often directed to the diversity now ruling in the wording of shipyard policies, and the striking similarity in all risks of the class makes it, to my mind, easy to construct a comprehensive form of wording for the items to be

covered, and there is no reason why the policy clerk should not be enabled to draft a shipyard policy or specification in all its completeness from the Surveyor's plan and report, the same as he performs that duty with the wording provided by tariff for other risks.

Take the following form as a basis, viz. :—

No. on Plan.	Description.	Building.	Machinery.	Stock.	Patterns, Drawings, Models, Moulds.	Total.

Many policies are now issued on these lines, and where separate sums are obtainable on more specific property, provision for this can readily be made.

There is undoubtedly a great want of uniformity in these policies, and a more general understanding with regard to division of amounts would in a great measure abolish the disproportionate assessments which are so vexatious.

Having regard to my previous remarks, the "Marine Clause" should be inserted in all these policies. Many warranties are obviously necessary and indispensable, but in my opinion it is not always desirable to make the policy an instrument by which a supposed guard against an existing danger is created. When defects are found in a risk the Office should see that they are removed before the policy is issued.

Some of the technical terms used about a shipyard are at once curiously interesting, although often incomprehensible to the casual visitor. For the purpose of reference I want to record the fact that all this technology is to be found in a good thick volume, "From Keel to Truck," by Captain H. Paasch (1894), a veritable casket of shipbuilding phraseology.

If you have heard, or if I have used, the word "puddening," you will wonder probably what it means. It is the name given to old rope, canvas, oakum, and rope yarns. "Junck," or "junk," does not always mean or refer to a Chinese vessel. Material for mops,

such as thrums and old condemned ropes, are known by this name. "Marine glue" is a mixture of shellac and tar, very adhesive, and employed to join closely pieces of wood, &c. "Caulking" is now generally understood to refer to the tightening of seams in iron and steel by closing the edges of butts, as also to the filling of the seams of planking with oakum to make them watertight.

And now, in my closing remarks, I have to express the great pleasure it has given me to construct this paper in connection with the staple industry of this great commercial district, and it has been particularly interesting since the trade is at present enjoying the greatest prosperity.

The returns for last year showed us another record. The resources of British shipbuilding and engineering establishments were taxed to the utmost measure of their capacity, and although the element which is emblematical of the purport of this paper has been somewhat predominant in the history of the industry, we are ever hopeful of the future; the outlook is promising, with the great improvements effected in recent years in the better arrangement and division of buildings and their roofs, and a more strict observance of the necessity of fire prevention and fire extinction.

You all know the old joke in the question, "What is a spiral stair?" Ninety-nine would indicate it thus (twirling the hand upwards), and the odd one only would tell you it was "a stair with steps radiating from a centre column or support." The feeling was upon me like that of the ninety-nine when I commenced.

It is impossible for me to detail all the sources from which much of the information embodied in my remarks has been obtained. I have been conscious of the fact that poor justice can be done to a subject of such magnitude in the time at my disposal, and that dry bones of fact never made a dainty dish.

In conclusion, gentlemen, you need hardly be reminded of the distinguished Clydeside names associated with the history of steamship development:—James Watt, William Denny, David Napier, John Elder, and others—each of whom has given his quota to the national story of progress and invention.

ARTHUR H. KNIGHT.

Insurance and Actuarial Society of Glasgow,
12*th March* 1900.

OBSERVATIONS ON THE PROGRESS AND PROSPECTS OF FIRE INSURANCE AS A SCIENCE.

THE first and most pleasing duty devolving upon me as the occupant of this chair is to tender you my sincere thanks for the high honour you have for the second time conferred upon me.

I do so with due appreciation and respect. When in 1891 you called me for the first time to preside over your deliberations, I felt that I was far from being the right man in the right place. Somehow I entertain the same feeling upon the present occasion, but the kindness and consideration of your Executive have been such as to encourage me to venture once more upon acceptance of the office, notwithstanding my own sense of shortcoming.

In searching for a subject on which to address you, my thoughts naturally turned to the present outlook in Fire Insurance business, and, on reviewing the matter further, I arrived at the conclusion that the current period in the practice of Fire business was one of steady development and transition, and that it might be interesting to many of you, and not unprofitable to myself, to submit for your consideration some "*Observations on the Progress and Prospects of Fire Insurance as a Science.*" This I now venture to do.

The business of Fire Insurance, although practised for over two centuries in this country, has only made solid progress scientifically during the latter half of the present century.

The progress of the business, as regards its extent or volume, has certainly been amazing. For instance, the whole property insured by all offices throughout England and Wales in 1800 amounted to £205,000,000 sterling—being less than *one-fourth* of the aggregate amount now insured in London alone; but the progress of fire insurance in the direction of arriving at accurate and equitable

rates of premium for the various classes of risk was slow indeed for more than a hundred years.

I may remind you that the first classification of risks (in 1682) consisted simply of two heads—(1) Brick Buildings and (2) Timber Buildings—the latter being charged double the rate of the former. At this time there was no insurance on the *contents* of buildings. With the advent of the "Sun" in 1710, contents were also insured (with certain exemptions); and some ten or fifteen years later a classification was introduced which lasted fully one hundred years, viz.:—(1) Common Insurances, (2) Hazardous, and (3) Doubly Hazardous. Afterwards a fourth class was added, to embrace extra hazards by special agreement.

When we consider the wide range and mixed character of the hazards embraced in the second and third of these classifications, it is surprising that the business could have been conducted with success on a basis so vague and inexact.

Fire Insurance has been sometimes facetiously termed a business of "magnificent guessing" (referring to those days, I presume); but the guesses, fortunately for the offices, brought out, on the whole, somewhat favourable results. Experts, however, gradually recognised that it was high time that more systematic research and greater exactitude should be exercised in the conduct of the business, for we find, in 1847, a well-known actuary saying in his preface to a work on *The Theory and Practice of Assurance*:— "There is one branch of assurance treated of in the Theory which "has not been sufficiently attended to in works which have gone "before. The branch referred to is 'Fire Assurance'; and should "its mention be the means of calling more consideration to the "subject, a positive good will be attained. The managers of fire "insurance companies have been deterred, no doubt, by the "labour of investigation from collecting the facts from their "Registers and Loss-books for a better classification of risks and "premiums. The author has no doubt, now that the spirit of "rivalry between companies is somewhat abated, that the time "is approaching when these matters will receive proper attention, "and the present loose and almost undefined method of estimating "premiums will give place to one of a more scientific and definite "nature, and the reproach be taken away which now attaches to "this part of insurance business."

In 1829 a tariff of minimum rates in regard to some important classes of risk in Scotland was established by a combination of the

managers of the Scotch fire offices; but it was not till the year 1858 that the leading British offices—who had for some years a general understanding as to the rates of premium on various classes of special risks—combined into what is now known as the Tariff Association, or Fire Offices Committee. The offices had made repeated attempts in this direction before, and, in fact, several tariffs—such as the cotton-mill tariff and some of the tariffs for city warehouses—existed previously; but the Association of the leading offices was not actually established till 1858. From that date tariff evolution made perceptible progress, greater exactitude prevailed, and combination of experience began to some extent to sway the conduct of the business.

It would be interesting to compare the earliest tariffs with those now in existence, and mark the progress and improvements which have been made in the specification and definition of the various elements of hazard, but the earlier tariffs are not accessible, and we must content ourselves with merely a general reference to the advancement which has taken place recently, more especially within the last ten years. There are at present in existence sixty-eight tariffs in all applicable to the United Kingdom, and of these, fifteen are entirely new tariffs, issued for the first time within the last decade. In addition to this, nearly all the older tariffs have been carefully revised and greatly amplified, and, in some cases, entirely remodelled. The alterations go on at such a pace that the surveyors and rating clerks at the various head offices and branches find it no easy task to keep abreast of the advancing tide. Every month brings quite a shoal of printed slips notifying changes in tariff items, risks, or rules. All this work must have made a heavy inroad upon the valuable time of the Fire managers of this country; and, as the work has been accomplished with much skill and discernment, it reflects the highest credit upon their business methods and capacity, and should produce in the future improved and more equitable results from those sections of the Fire business affected by the alterations.

Tariff legislation has made greater progress within the past ten years than it has ever done in any previous period. The number of entirely new tariffs issued in the ten years *immediately prior* to the current decade was three only, against fifteen, which shows considerably greater activity in the later period.

While much new ground has been covered, there is still much to overtake; and many important classes of risk are still quite

free from the enactments of the Associated Offices, such as engineering and metal-working risks, shipyards, calico-printing works, bleach, dye, and finishing works, paper mills, alkali and other chemical works, sawmills, joiners' shops, and cabinet works.

There is a general understanding as to the minimum rates for such risks which has either been handed down by tradition, or established by current practice; but many of the prices current are known to be notoriously unprofitable, and the skill of the individual underwriter has full play in discriminating as to what risks to avoid, or where to restrict lines on those accepted.

It is difficult to ascertain from reliable statistics the proportion of tariff to non-tariff business in the United Kingdom, but the following is probably a fair approximation:—

I. Tariff-rated Risks, including dwelling-houses and other non-hazardous risks for which there is a minimum rate of 1s. 6d. per cent., say eighty per cent. of total premiums.

II. Non-Tariff Risks, say twenty per cent. of total premiums.

As a general rule the Associated Offices never formulate a new tariff for any class of risk until it has been demonstrated beyond question that the current premiums at which the risks are being carried are grossly inadequate, and even then they temper their legislation with fairness and moderation.

In the earlier days of the tariff system, after a disastrous experience of heavy losses in any class of risk, or in dock or warehouse risks, under mercantile tariffs, the Associated Offices were inclined to resort to panic rates as a remedy, with the view of speedily recouping the heavy losses sustained, but it was found that that remedy created other evils quite as difficult to deal with; for it resulted in the formation of rival non-tariff offices, who competed for the business at lower premiums than the advanced rates of the Associated Offices. This was notably the case after the great Tooley Street fire in 1861, and the numerous and disastrous fires in the Lancashire cotton mills a quarter of a century ago.

The Fire Offices Committee now act in such matters with greater deliberation. Statistics extending over a period of years are carefully considered and weighed before any important change is given effect to, and as a consequence they have, as a rule, little difficulty in proving and defending the justice of their rating.

As a proof of the moderation and fairness of the premiums charged by the British fire offices, taken in the aggregate, you have but to refer to the published returns given from year to

year of the results of the business. Last year the fifty-four British fire offices paid in losses and ordinary expenses 94·6 of their premiums, leaving a margin of profit of less than 5½ per cent. from which to pay dividends, add to reserves, and provide for abnormal conflagrations. Curiously, this result, instead of being that of a specially bad year, is almost exactly the average of the past eighteen years, the margin of profit for that long period having been about 5¾ per cent. of the total premiums, and the present year promises to be considerably worse than the average. It is further well worth calling attention to the fact that this margin of profit has *not* all gone in dividends to shareholders. In fact, less than one-half of the profit referred to has been so paid. I believe I am within the mark when I say that not much more than 2½ per cent. of the total premiums received by the British offices within these eighteen years has been transferred to the pockets of the shareholders, the balance having gone to the strengthening of the reserve funds—a most essential process in the interests of the insuring public, inasmuch as it augments materially the protective value of the fire policies affected.

When we consider further that these returns include all the gilt-edged business of the old-established offices, it must be freely admitted that this enormous business (nearly twenty millions sterling annually in premiums) is being worked on the smallest possible margin of profit consistent with ordinary prudence and adequate protection to the insured. In fact, the profit is so small that it is simply impossible for non-tariff offices with a like experience to exist, supposing that they even confine their reductions in rate to a modest 5 per cent. overhead, and we all know that they are not quite so modest as that! That the directors of the British companies should be able or content to conduct such an exceedingly risky business on so slender a ratio of profit is highly creditable. They certainly could not afford to do it but for the interest on the reserve funds (a *decreasing* return unfortunately) which have accumulated over a long series of years.

The combination which exists among the insurance companies for the purpose of fixing proper rates, according to the actual experience of the Associated Offices, is a vital necessity of the business, as no individual office, however extensive its transactions, would be safe in fixing rates of premium solely from the results of its own operations. Such an experience would be obviously

incomplete and partial. The wider and more complete the area from which the statistics are derived, the more reliable the expectation must be on which to build up a correct rate. The combination, therefore, in addition to being a vital necessity, is an actual benefit to the insuring public, so long as the rates fixed are not excessive, and the results I have quoted go to prove that it would scarcely be possible to conduct the business at a lower ratio of profit than that which it is yielding at present. If undue profits are being realised in any section of risks, it speedily becomes known, and competition, either by new or existing offices, steps in with a view to secure any benefit that may be derived from a transfer of the business at a more moderate margin of profit. Excessive rating, therefore, works its own cure, and as it ultimately gives the Associated Offices a great deal of unnecessary trouble in the process of correction, the combination of offices have long ago learnt the lesson that fair and equitable rates are best, both in their own interests and in the interests of the public.

Still, there are undoubtedly a great many inequalities and anomalies in rating which call for correction. These, for the most part, have been inherited from the looser and cruder methods which prevailed in the early days of fire insurance, and are gradually being investigated, reconsidered, and remedied. Ancient traditional practices die hard, and before it is possible to carry any radical changes, absolute unity of opinion must prevail, and that is by no means an easy attainment. In the meantime, the public are not badly off, as the results quoted amply testify, but it would enable the offices to justify and defend their charges for the various risks more effectively if the latest advances in the measurement of fire hazard were more generally introduced into our various tariffs.

Mr. Kingsley, in his admirable paper on "Tariff Legislation and Risk Improvement," delivered before our Society last session, draws very forcible attention to the fact that our existing tariffs vary much in character and effectiveness. He notices the weaknesses and inconsistencies with which some of them abound, and very properly defines a good or ideal tariff as one that makes for risk improvement by penalising the faults and hazardous features of the risks with which it deals, and by setting up a high standard of excellence in risk. He says:—"It has always seemed to me "that one of the main objects of a tariff should be to establish a "standard risk, to set up a model of the best buildings, the best

"machinery, and the best conditions for the particular business to "which it applies. This is done to a greater or less extent, "*indirectly*, in most tariffs, but I see no reason why the 'Standard "Fire Risk' should not be more explicitly defined and set forth "than it is at present."

While, therefore, the business of fire insurance is making perceptible progress on more scientific lines, there is still a great deal of ground to be overtaken.

It covers such a wide and varied field. The contingencies of the fire hazard are so multifarious—varying, in a city, from the simple, substantial, detached dwelling-house to the gigantic wood-lined structure crowded with sundry sorts and conditions of hazardous goods and trades—sometimes with the use of defectively-fitted steam boilers and stoves, and subject to the conflagration hazard of a congested city area, plus that indefinable contingency which we call "moral hazard," and which is liable to emerge at any time to disturb the most careful calculations.

With elements and features of risk so intermixed and so complicated by situation, by height, by diverse construction of building, by the infinite variety of processes of manufacture, by placement of hazardous goods, by the more active risks of artificial heating and lighting, by bad or indifferent management of premises, not forgetting the presence or absence of extinguishing appliances of all grades of efficiency and non-efficiency, is it matter for wonder that fire underwriters should have been almost baffled in their efforts to define and measure with accuracy such a complexity of hazards?

The most advanced and the most able and striking contribution which has yet been made in the direction of analysing and measuring with detail and completeness the fire hazards of city mercantile risks was published in the United States of America a few years ago by a committee of experienced underwriters, and is known as *The Standard Universal Schedule for Rating Mercantile Risks.*

In the words of the Chairman of this Committee (Mr. F. C. Moore), by "schedule rating is meant a specific, accurate measure, "from the standpoint of advantage or disadvantage, by a scale of "insurance rates or prices for every feature of a building and its "contents, of construction, occupancy, fire resisting or extinguish-"ing provisions, and also of its environment or surroundings—"involving, in the latter, consideration of such features as the

"liability of the city in which the building is located to conflagra-"ations, the width and grade of its streets, its previous fire "record, the police and fire departments, and, in fact, every "consideration which an ideal underwriter possessed of the "knowledge and experience combined of all engaged in the business "would take into account in fixing a rate."

I may mention that "schedule rating" has been practised in the United States for at least twenty years, but it is only within the last *ten years* that it has been so much developed and improved —the Universal Schedule referred to being, for thoroughness, greatly in advance of all previous attempts in the same direction.

The Schedule Committee explain further:—"The mere fact "that there are more than one hundred features of construction "in a single building which should enter into consideration of its "rate, irrespective of nearly forty features of its city or environ-"ment, nearly forty more different features of fire appliances, to "say nothing of more than one thousand possible hazards of "occupancy; and the further fact that no individual knowledge is "equal to the task of putting a price upon so many items, nor "any individual memory capable of remembering them, proves, "without further demonstration, the necessity not only of con-"ference to secure combined knowledge for fixing prices, but also "a printed record or schedule to prevent omissions or mistakes."

The schedule recognises:—

(1) A Standard of Environment: *The City.*—A standard city is described, involving wide streets, gravitation water-works, adequate fire department and pipe service, and other features; also, a previous five-year fire record of not exceeding five dollars annual fire loss to each thousand dollars of insurance, as shown by the books of the principal Insurance Companies.

(2) A Standard of Construction: *The Building.*—A standard building is described which may be regarded as a model of ordinary construction, not fireproof.

(3) A key or basis rate (an equivalent for the *normal* rate in our tariffs)—twenty-five cents per hundred dollars of insurance—is fixed as the basis rate for a *standard* building in a *standard* city.

To ascertain the basis rate of a standard building in any city or town *differing from the standard aforesaid*, additions are made according to the deficiencies of the city as to water-works, fire departments, building laws, inaccessible or narrow streets, excess in fire record, etc., etc.

"This key rate, so determined, is thereafter used to obtain the "rate of any building in the city to be rated by adding to it "charges for its deficiencies from the specification of a standard "building.

"The thickness of walls, the quality of bricks and mortar, "character of roofs and floors—and especially of floor openings—"area, height, skylights, heating, lighting, etc., are carefully "charged for according to their relative importance in determin-"ing which the charges for the various features of buildings "construction, etc., are graded according to their tendency to "contribute to the destruction of the building by fire."

Having ascertained the rate which the building should pay for its own inherent or structural hazard, the schedule then deals with the charges which are dependent upon the nature of its occupancy.

A list of stocks, trades, and callings—over a thousand in number—is given, having two columns: the first containing the figure which should be added to the *building* rate to measure the danger of the occupancy by reason of its tendency to cause fires or as affording fuel for combustion (what is termed the "ignitibility" and "combustibility" of occupancy); while in the second column is a charge for rating the *contents* themselves, being that figure which should be *added* to the building rate to determine the rate which its movable contents, merchandise, etc., should pay because of their susceptibility to damage from water, smoke, heat, etc.

The treatment of *stocks as compared with buildings,* as indicated above, constitutes one of the most striking features of the Universal Schedule. The rates fixed for *stocks* are almost invariably in excess of those charged for buildings, the excess varying from twenty to two hundred per cent., according to the susceptibility to damage or combustibility of the goods.

The schedule points out that "in direct ratio as a building "approaches standard construction, and in direct ratio, also, as "the city in which it is located approaches the standard city as to "water-works, fire-extinguishing appliances, &c., will the difference "between a building and the merchandise contained in it increase; "in other words, the better the construction and fire department, "the better will be the building as a risk compared with the stock, "and the poorer the construction and fire department, the less "should be the difference in rate between the building and the "stock."

When we consider that in nearly all the British tariffs, even in

those applying to the larger cities, the rate chargeable for building and for contents is identical, one is almost inclined to question the wisdom or accuracy of making such a wide difference in rating as that provided for in this schedule. The only exceptions with us which I remember at present are the Belfast warehouses tariff (where the normal rate for building is 4/- per cent., against a stock normal for linen yarn of 7/6 per cent.), and the farming property tariff, where the buildings may be insured at 3/- per cent., against 10/- per cent. for agricultural produce, and the shops tariff (Scotland), which applies to contents only, unless in a few important cases where it is provided that the rate for building shall not be less than three-fourths of the rate for contents.

Having regard to sound principle, it must be at once conceded that there ought to be, in many cases, a material difference between the stock rate and that for the building, and I think we may confidently look for a better recognition of the principle in British rating in the near future. Partial losses represent more than 90 per cent. of the whole number of fire claims, and in nearly every case of partial loss the percentage of loss to value is considerably greater on stocks than on buildings—the loss ratio on stock being frequently four or five times that of the building. In some cases, where the stocks are highly susceptible to damage, the difference is quite startling. A good many years ago this was well illustrated by a Glasgow case. A fire occurred in a large warehouse containing hats, boots and shoes, drapery, artificial flowers, &c., resulting in a damage to *stock* of 27 per cent. of the total value, while the damage to the building in which the fire occurred represented less than *3* per cent. of its value.

The principle is a very old one in fire insurance, and has been recognised from the first in the commonest of all insurances (although not by tariff enactment), viz.:—Dwelling-house risks, where the building is charged 1/6 per cent., and some of the contents, such as pictures, as high as 4/6 per cent.

Having this example so constantly in view, it is not easy to account for the almost total abandonment of the differential principle in our tariffs generally, especially in those applying to shop and warehouse risks in larger towns and cities protected by efficient fire brigades. It is one of those anomalies for which, in the interests of scientific underwriting, the offices would do well to provide some relief or remedy. I am not, however, prepared to advocate such a general recognition of the principle as that formulated in the "Universal Schedule."

Another distinguishing feature of the Universal Schedule is its detailed method of dealing with *fire departments and extinguishing appliances*, which, as the schedule explains, must receive threefold treatment and be divided so as to apply—

(*a*) For the minimum credit, to all risks benefited as regards conflagration hazard or danger from sweeping fires.

(*b*) For the maximum credit, for full protection only to those risks entitled to it by reason of proximity to hydrant service, fire-engine houses, size of street mains, accessibility to streets, etc.

(*c*) To buildings separately from stocks.

Our American friends say that all other systems of rating give these appliances *single* treatment, rating all risks in a city as if they shared equally in the benefit of a fire department, whereas acres of buildings and stocks may be on the lines of insufficient water pipes and remote from engine service, and thereby inadequately rated.

The schedule, by a system of deductions, provides separately for all these deficiencies, and it also provides for stocks and buildings being separately treated as regards the means for fire extinction, inasmuch as the value and efficiency of water-throwing facilities differ as to stocks and buildings.

In connection with this subject, it would establish a manifest improvement in the practice of the offices in this country were they to agree to adopt a complete and uniform system of dealing with the means available for fire extinction, applicable to all tariff risks, and to all risks for which a minimum rate is fixed.

Many of the smaller towns in the United Kingdom are unprovided with the most ordinary requirements for fire extinction. Many mansion-houses and other dwelling-houses situated at a distance from towns are in the same position. These risks, including dwellings in towns, are not subject to any specific tariff, but they come within the scope of the minimum-rate tariff, which prohibits a lower rate than 1/6 per cent. for any risk whatsoever.

One of the least defensible anomalies in the conduct of the British business is the possibility of insuring these risks, when situate quite beyond the reach of any adequate means for extinguishing fire, at the same rate of premium as similar risks protected by the most efficient appliances. This procedure is certainly the reverse of scientific, and calls for readjustment.

It would appear to be well worth considering whether it would not be possible to formulate a detailed minimum standard of the means or appliances necessary for fire extinction, whether public

or private, with which all normally-rated tariff risks and all risks rated at the minimum rate must comply; and failing which, that each deficiency or variation from the standard should be charged with a small percentage of extra rate in accordance with its estimated value. A deduction could afterwards be made from the total rate in certain cases for specially efficient appliances in excess of the standard.

If such a scheme were sanctioned and made obligatory, all mansion-houses and other dwelling-houses unprovided with, or beyond the reach of, effective means for extinguishing fire would very properly fall to be charged at a somewhat higher rate of premium than those dwellings which are adequately protected. The effect generally of such a measure would be to increase materially the provision for fire extinction in places where it is at present most urgently required.

In this connection it may be noted that mansion-house fires are frequently very destructive, the loss being too often almost total. This result is believed to be largely due to the absence or inadequacy of the necessary fire-extinguishing facilities. Many offices now carry considerably reduced lines on this class of risk, a procedure which plainly indicates that the class is not in high favour at current rates.

Insurance experts are now pretty well agreed that these risks might very reasonably be dealt with by separate tariff, for the following, amongst other, reasons, viz.:—The large area of the building, the diverse methods of heating and lighting, the exceptional value of the contents, the frequent deficiency in the arrangements for fire extinction, and the recent unprofitable results.

Reverting again to the Universal Schedule, there are many other points in it well worthy of careful study to which I should like to have drawn your attention. I have used in the foregoing description, as far as possible, the actual wording of the explanations and statements attached to the schedule itself; but the account which I have given is too meagre to convey a perfect idea of its contents. I must refer you to the schedule itself for details.

It has certainly been elaborated with remarkable and unique completeness. Such a scheme (intended for universal application so as to secure uniformity in the basis of rating for all mercantile risks), while taking into account every feature of construction and every feature of fire protection and extinction, is, as I have

already indicated, without parallel in this country, and, if found effective and workable in practice, its influence might be far-reaching and important.

Although the scheme has been before the insurance world for some years, the fire underwriters of Great Britain do not appear to have given it all the attention to which it is eminently entitled. They are probably waiting to see its effect in the land of its birth.

It seems to be admitted that the provisions of the schedule, although sub-divided into the minutest details of fire hazard, are on the whole rightly assessed and practically unassailable on the ground of inaccuracy of definition—in fact, the fire hazard seems to have been reduced by this scheme to its primary constituent elements.

In discussing the question as to whether the schedule is not unnecessarily long, the Chairman of the Committee says:—"If "there be a single item in it which ought not to be considered by "an underwriter in fixing his price or line, it should have been "omitted; but if there be no such item, then the schedule cannot "be too long."

The basis rate must, of course, vary in different cities according to the fire-record results for the previous five years, and a difference of opinion may occasionally arise as to whether the proper value has been attached to some of the items of hazard enumerated, but there can be no question that it is the most advanced analysis or exposition yet formulated in regard to the fire hazard, and as such should be carefully studied by all those engaged in the business who desire to surmount the obstacles which have hitherto beset the path of the underwriter in his efforts to secure accurate rating. I cordially recommend the fire insurance members of our Society to make themselves thoroughly familiar with the contents of this schedule, to master its details so as to apprehend and remember the fresh items and sub-divisions of hazard, and to apply the knowledge thus obtained when inspecting and estimating the fire risks of our own country. I think it would augment the interest we already experience in our daily round of duty, and make us more readily adopt improvements in the practice of our business when an opportunity for doing so presented itself; in fact, it would probably convert us into advocates for the inauguration of a more uniform and equitable system of rating than that at present in vogue in our midst.

Perhaps I may now be permitted to glance, and that briefly, at

the *prospects* of further development in the practice of fire insurance as a science in the United Kingdom. I can only do so by indicating the direction in which that progress is mainly required with the view of achieving more exact and equitable results.

I have already referred to two of the points under which advancement may be looked for, viz.:—Differential rates for buildings and certain stocks; and the uniform treatment of fire-extinguishing appliances.

Experts are mostly agreed that tariff legislation must advance with the times, and it is no doubt doing so steadily, if slowly. Old-established offices do not readily relinquish their individual freedom in such matters, and some of the managers who have been specially successful with their results in the past are doubtless inclined to think that we had better

> "Bear those ills we have
> "Than fly to others that we know not of."

Be that as it may, the march of progress and the demands of the age, which are mainly those of searching enquiry and criticism, necessitate greater uniformity and precision in the ascertainment of the proper rates of premium for the various classes of risk, and a bolder step forward at a comparatively early date on lines akin to, or based upon, those of the Universal Schedule used in America, may not be altogether improbable, so far as regards the rating of town and city risks, in lieu of the city tariffs which are in use among us at present, and which, as Mr. Kingsley says, "display a curious diversity of treatment."

I feel quite sure that those who are engaged in fire business in this country are not prepared for such a drastic step as the adoption of the Universal Schedule *in its entirety* would involve. In fact, the materials for such adoption are not yet obtainable. The schedule, here, must for some time continue to be looked upon as educational.

The process of analysing the fire hazard to its minutest elements is undoubtedly an interesting and useful study, and of much value in considering the relative merits of individual risks and the lines to be held thereon, but many of the sub-divided items of hazard in the schedule may be taken as grouped together under fewer headings in our present tariffs, and charged for in that way. This may continue for a considerable time, and it appears to me to be doubtful whether the smallest of the items of hazard will ever fall to be charged for separately.

In this connection a partial comparison is possible between the *life* risk and that of the fire.

Amongst, say, 1000 average lives accepted at the ordinary tabular rates, there is undoubtedly a distinct gradation possible (and probably even advisable) in the relative value of the various lives as regards their prospects of longevity. Some are remarkably robust, active, big-chested, strong-hearted, descended from a long-lived race, and having not the slightest taint of hereditary disease in the family history. Others, again, while free from organic disease, are somewhat narrow-chested, sedentary, neutral as regards physical stamina, with possibly a trace of hereditary ailment in the family record. Should the former in strict equity not be assured at lower rates of premium than the latter? I certainly think so, and if rates of premium were fixed more narrowly in accordance with personal condition and family history, there might be several grades in the scale of premium, even amongst those lives which are at present all classed as "Ordinary." Yet, I must confess there is no crying demand for a change of practice in this respect. In like manner there is not yet any strong call upon fire offices to differentiate their rates of premium to such an extent as to make a separate charge for the smaller items of hazard. If the total number of risks affected by these smaller hazards are insufficient to form a good average, then it appears to me that it would be preferable to group such with their "next of kin." This is a matter, however, which could be adjusted by experience in working the schedule.

While, therefore, it is useful, interesting, and highly educational to have such a complete and searching analysis of the fire risk such as this schedule supplies, we are certainly not yet ripe for its full adoption; but that is no reason why some movement should not be initiated with a view to securing a fuller, more accurate, and more uniform definition of the various factors of hazard than that which is at present formulated in our different tariffs; and it appears to me that if the essential features only of the Universal Schedule, modified to suit our special circumstances, were agreed to, and acted upon in this country, it would go far to place our fire insurance business on a perfectly defensible and irrefutable basis.

In regard to the actual use of the universal schedule in America, I have been informed, in reply to recent enquiries made of Mr. F. C. Moore, the Chairman of the Committee, that the

schedule "is in successful use in Boston, Pittsfield, Rochester, "Albany, Cleveland, St. Paul, New Orleans, San Antonio (Texas), "Waterville, Denver, Scranton, Minneapolis, and in part in "other cities, besides having an important effect upon rating "schedules based upon it in use in Indiana and most of the other "States." Mr. Moore writes further that U.M.S. Committee still exists, but "it has not made any further report on the subject "to the National Board of Fire Underwriters or other association. "The reason for this is that no requests have been made to alter "the schedule in any respect—a result due to the fact that the "Committee before issuing it originally canvassed so widely for "criticism, not only in this country, but in Europe. I, of course," he says, "realise that there must be mistakes in it, and that "certain charges may be changed with the development of time; "but, so far, we have had no reason to alter it in any respect."

Although the United States has thus evidently stepped beyond the home country in the development of the theory of rating in fire insurance, yet it must be confessed that they do not always support their theories by consistent practice. Witness their violent rate wars, and the disastrous results thereof, when theory goes by the board; but the conflict, being sharp and sore, is quickly over, and a speedy return is made to sane and reasonable methods.

In Great Britain there is possibly a stronger element of conservatism in our character, and we are slower in our movements, and do not readily throw any well-based experience to the winds. When once a tariff has been formulated and accepted, its complete cancelment is a rare occurrence. The only important tariff which, so far as I remember, has ever been suspended for any considerable period is the Cotton Mill Tariff (England), which was cancelled in 1885 and remodelled and re-enacted in 1892, during which period "the companies vied with one another in offering "insurance to cotton spinners at less than cost price, and in "bribing them to fit up their mills with automatic and other "extinguishing appliances."

Although we cannot but deprecate, in this connection, the violent irregularities in practice which now and again break out in the United States, there is no reason why we should not admire the soundness and accuracy of their rating theories, and seek to adopt them as far as practicable, because if consistently applied and practised they would unquestionably result in the distinct advancement of fire insurance on scientific principles.

Classification of Risks and Losses.

Many of the offices have introduced, and maintained for years, an elaborate system of classification of the various risks upon their books, with a record of the losses annually accruing in each class. In this way the annual profit or loss on each section of risks can be ascertained, and the record is a very necessary and instructive one to refer to in considering both rates and limits.

It is unfortunate, however, that a uniform system of classification has not been agreed upon by all the offices, as this would greatly facilitate a combination of the whole experience on each class of risk at stated periods, and, without this, absolute accuracy in the measurement of adequate rates is not obtainable.

If a dozen of the principal offices were to agree upon a complete and uniform classification, the other offices would probably fall into line; and in regard to the collection of these more uniform and complete statistics as to fire losses, probably the different Salvage Corps, with the assistance of the various fire loss assessors, would be able to prepare annually a return based on the risk classification referred to, giving in all available cases full information as to the origin of the fires and the precise location of the outbreak. The want of full information on these points has been keenly felt in the past, and the absence of any such arrangement has resulted in the loss of most valuable data which might otherwise have served as a beacon to reveal danger, or as a guide to the channel of safety. One must look both to the present and the rising generation of insurance men to do all in their power to overcome existing difficulties, in order that the legitimate progress in this direction which is so much required may not be unduly retarded.

I have often wondered that one of our prominent and enterprising insurance journals has not undertaken to publish an annual classified list of the fire losses in the United Kingdom. Several of them publish with each issue a record of the fires which have occurred from week to week, or month to month, and, while such records are useful, their value would be greatly enhanced if the amounts of the losses in each case were carefully ascertained and classified, at the close of the year, by an insurance expert. An annual publication of this kind could not but prove highly educative and of wide utility to the fire underwriter, especially in regard to those classes of risk not rateable by tariff.

Salvage Corps and the Systematic Inspection of Risks.

Mr. Postdown, in his instructive paper on Salvage Corps, delivered before our Society last session, pointed out very clearly the advantages which would be derived from the establishment of additional Salvage Corps in the more important cities and towns of the United Kingdom, and, as I have indicated above, one of the new duties which could be advantageously devolved upon them would be the compilation of classified statistics of the entire fire losses of each district. One of the most important duties at present performed by part of the staff of the Salvage Corps is the systematic inspection of warehouse and other risks.

In Glasgow this has been found to be one of the most effective means by which a diminution of the fire hazard has been and is being secured. Mr. Postdown reports that during the six years ending 1897 over 10,000 defects in the risks inspected were discovered, nearly the whole of which had been remedied. "Many of these defects were of a serious character, and it is "believed that their removal has had an undoubted effect in "reducing the fire-loss ratio in the district."

As the fire offices maintain only three separate Salvage Corps in the United Kingdom at present (London, Liverpool, and Glasgow), it follows that the number of corps would require to be greatly increased if all the large towns were to have the benefit of this united and systematic inspection. The increased outlay involved in doing so would be more than recouped by the saving effected at the various fires attended, and by the benefit derived from the improvements in risk effected during the course of inspection.

If our large cities are ever to be rated on a uniform system resembling to any extent the Universal Schedule, it would be necessary to have the risks supervised and reported on by thoroughly skilled surveyors, or Salvage Corps officers, acting under the guidance of an Executive Committee of the fire offices, as only in some such way could we hope for its successful and effective introduction.

In the address which I had the honour to deliver to this Society in 1891, I laid stress upon the immense practical benefits of concerted action by the offices in regard to the systematic inspection of city risks, and I need not, therefore, again enlarge upon this topic, as all I then said in its favour is as true to-day as it was then.

THE AVERAGE CLAUSE AND THE PERCENTAGE CO-INSURANCE CLAUSE.

As a matter of strict equity, I think it may be safely maintained that the average clause ought to form part of every insurance contract. If an insured elect to carry a proportion of the risk on his own shoulders, strict justice would seem to demand that he should be debited with his due proportion of every loss that may occur, be it small or great.

Over the continent of Europe generally, and in most foreign countries, fire policies are scarcely ever issued without applying the *pro rata* average clause. Its omission in cases where the property is largely under-insured places the insuring offices at a great disadvantage in the event of a partial loss, and it is somewhat unfortunate in the interests of the fire insurance business of this country that the public have been so long accustomed to its omission, and the consequential benefits thereof, that they would in all probability strongly resent any measure adopted by the fire offices for its introduction into specific policies generally, especially these covering non-hazardous risks. Rates of premium are generally based on the understanding that an adequate amount is insured, or, in other words, that an amount approaching the full value of the property is covered. When this is not the case, or where an insurance is effected for only a small portion of the value, the results are absurdly one-sided, and are such as to make one wonder that the fire offices have so long tolerated a practice which is nothing short of folly. To give an actual case which occurred recently:—Property worth £5000 was insured for £1000 only. A fire occurred, doing damage to the extent of £500, which had to be paid in full by the insuring office, being a loss of *50* per cent. of the sum insured. If the full value of the property—£5000—had been insured, the same loss would only represent *10* per cent. of the insurance, and yet the total premium paid in the latter case would have been five times that of the former! Stated otherwise, the loss in the first case amounted to 100 times the annual premium, and in the latter case the same loss would represent only 20 times the annual premium.

It is manifestly impossible to arrive at accurate rates of premium if the insured are to be allowed such a latitude in selecting the proportion of value for insurance without average.

The offices are becoming more alive to the necessity which exists for reform in this direction, and we find that the application

of the *pro rata* average and the "three-fourths clause" is rapidly on the increase in our tariffs. It is obligatory to apply *pro rata* average either to buildings and contents, or to contents only, in 23 of our existing tariffs, and the "three-fourths clause" to contents in other 5 tariffs, making 28 tariffs in all in which average, or a modification thereof, is now insisted upon in the case of specific insurances. Ten years ago average in specific insurances was applicable in less than 10 of our tariffs, showing a great advance in the recognition of this equitable principle within recent years.

As a rule, however, average has only been introduced into our tariffs in cases where the classes of risks affected have been for years unprofitable, and with the view of obviating a larger advance in the rates of premium. This is another proof of the caution and fairness displayed by the tariff offices in the conduct of their business.

In America the percentage co-insurance clause is being gradually introduced into nearly all specific policies, as the next best substitute for *pro rata* average, and the rate of premium is graded according to the proportion of value insured.

The following is the New York standard co-insurance clause: —"If at any time of fire the whole amount of insurance on the "property covered by this policy shall be less than 80 per cent. of "the actual cash value thereof, this company shall, in case of loss "or damage, be liable for such portion of such loss or damage as "the amount insured by this policy shall bear to the said 80 per "cent. of the actual cash value of such property. It being under- "stood and agreed that in the event of loss or damage not ex- "ceeding 5 per cent. of the whole amount insured, on articles "damaged, said co-insurance clause shall not be applied in adjust- "ing said loss."

This clause, while not so severe as the full average clause, is, of course, vastly preferable to the British practice, in most cases, of having no clause of the kind at all, as it secures a reasonable percentage of insurance against value at risk, failing which a higher rate of premium is exigible.

The co-insurance clause is most valuable in cases where the risks are under the protection of efficient fire-extinguishing appliances, as the losses under such conditions are almost certain to be only *partial* in the great majority of cases.

In the better fire department cities of the United States it has been calculated that only 5 per cent. of the whole losses in

number are over 80 per cent. of the value of the property, 5 per cent. in number are between 50 and 80 per cent. of the value, 7 per cent. between 25 and 50 per cent., and no less than 83 per cent. are under 25 per cent. of the value of the property.

Probably our proportion of partial losses in this country is not so great, but the above figures bring into prominent relief the dangerous fluctuations which must occur in the loss ratio when policies are issued without any stipulation in regard to the percentage which the insurance is held to represent of the value at risk.

It will be noticed that the co-insurance clause quoted is held to be inoperative in the case of trifling losses, in order, no doubt, to prevent the inconvenience and expense which would be entailed in valuing the whole property at risk in such cases. A similar objection is often used as an argument against the application of average to home risks, and it might be worth while considering whether, in furtherance of a more general application of average to certain risks, it might not be possible to introduce a like exemption here.

We certainly cannot hope for the application of the full average clause to insurances in this country over non-hazardous risks for many years to come, but even a 50 or 60 per cent. co-insurance clause would go a long way towards checking the flagrant instances of under-insurance which are becoming every year more prevalent, especially in connection with insurances over the larger and more substantially built properties.

Uniformity of Policy Conditions.

When offices agree upon the identical premiums to be charged for certain risks, as they now do by so many tariffs, it is not unreasonable to expect that the terms and conditions of the fire policy or contract should also be identical, in order that the promise of protection, secured by the premium, may be similar in kind and extent; or, in other words, that one policy, in event of fire, should not, through its more stringent stipulations, get off more cheaply than another of like amount covering the same property.

If the conditions of one or more offices be more stringent and less favourable to the insured than those of other offices upon a risk, then the difference in the degree of protection is capable of

being estimated in the rate of premium, and the insured would probably be justified in claiming a modification in rating in such circumstances.

The insuring public, however, seldom look at the printed conditions of their policies until a fire occurs, when rectification is not obtainable. They seem, not unnaturally, to be under the belief that offices charging the same rate of premium have identical policy-conditions. Unfortunately this is not the case, and at the present time the variations and discrepancies between policy-conditions of tariff offices are very considerable and have had a decided growth within recent years.

In the earliest years of fire insurance the differences were of course considerable, as the conditions were then only in course of development. This continued for many years. Some of the earlier conditions were remarkably shrewd and useful, and the revival of a few of them in the present day would not be unwelcome, at least to the offices. For instance, the following would be helpful in the direction of full inquiry into the origin of fires:—

"When any sufferer receives his or her claim, 5 per cent. shall "be deducted out of it for defraying the charge and expenses of "officers and others employed to make enquiry how and by what "means the fire happened, as is usual in other fire offices."

With the lapse of years, competition amongst the offices in regard to fire policy-conditions appears to have increased, and several salutary conditions, such as the one just quoted, disappeared from the contract. It was not till 1870 that any genuine approach to uniformity was actually secured. In that year the principal British offices adopted a uniform fire policy with revised conditions, and for several years thereafter it looked as if uniformity had come to stay. Gradually, however, and partly in consequence of decisions in law affecting some of the conditions, alterations and revisions were made by individual offices, and at the present time the existing differences are greater than they have been for many years. Some offices still maintain the conditions of 1870, which were twelve in number. A good many other offices have now 15 to 21 conditions, some of them entirely new. For example, a few of the offices have introduced the American cancellation condition, which provides for the insurance being "terminated at any time at the option of the

"company on giving notice to that effect and refunding a rateable "proportion of the premium."

If this option were exercised during mid-term, owing, say, to an epidemic of fires or to unforeseen dangers threatening certain risks, it would place both the insured and the other offices interested at a great disadvantage.

I find, again, that certain offices have revived one of the century-old conditions rendering the policy void if, at the time of effecting the contract, the other insurances on the same property are not disclosed and allowed, or if notice be not given on later insurances being effected during the currency of the policy. If this condition were enforced it would also, in many cases, place other co-insurers at a disadvantage as well as the insured.

Time will not permit me to discuss or even enumerate the existing discrepancies, but they are many and important, and extend to nearly the whole of the conditions. These divergent conditions are unfair in many respects both to insurers and insured, and, as all policies contain a contribution condition, they are bound to cause delay and disputes in the adjustment and apportionment of losses. Due regard should be paid to the requirements and convenience of the public in such a matter; and there can be no doubt that it would be mutually advantageous were the offices to agree to sink their distinctions for the benefit of their clients and the consistent development of the whole business. If an agreement securing uniformity of premium does not also secure uniformity of contract, the object of the agreement is defeated, as the liability for loss payments under policies on the same risk must vary according to the observance or non-observance of the differential conditions. If these unfortunate conditions in policy-conditions are maintained or become accentuated, the representatives of some offices may be expected to revive the ancient form of competition and seek for new business by pointing out that *their* policies are more valuable than others in respect of their freedom from certain restrictions. This sort of competition would be very demoralising and might lead to much complication in the working of the business. Let us hope that some arrangement may be made to avert consequences so destructive to scientific progress.

The fact that all offices in accepting re-insurances from each other abandon their own conditions and follow those of the office

which they guarantee is sufficient of itself to prove that the obstacles to uniformity are not insuperable.

Such varying conditions do not exist generally in the United States. In New York State and many other States the use of standard policies with uniform conditions is, by legislative enactment, obligatory upon all offices doing business there, and we have it on high authority that the settlement of this question by the Legislature has operated to the advantage of both the insurer and insured.

I am afraid both my time and your patience are now fully exhausted.

I have endeavoured to show that the business is gradually being built up and developed on stable and scientific lines, and that the progress in this direction during the past ten years has been accelerated. I have endeavoured also to sketch the probable lines of future progress. In doing so I assume no prophetic rôle. These prospects may become less bright, or they may even be blighted by the bitter winds of adversity.

> "Oft expectation fails, and most oft there
> Where most it promises."

That is sometimes true of our best risks and our best prospects. In such circumstances we must seek refreshment in a consoling draught of

> "Adversity's sweet milk, philosophy."

Judging, however, from past progress, we are entitled to expect that those practices which at present most strongly retard scientific advancement will be among the first to be merged in the tide of improvement.

If the same rate of advancement be made in the coming decade as we have had in the one that is past, there should be some reason for satisfaction. We must remember that no drastic reforms in practice or procedure can be satisfactorily secured until practical unanimity of opinion prevails amongst the whole body of offices, and that ideal state of affairs is not easily attained. To attempt to force the pace unduly might ultimately retard rather than accelerate the march towards the desired goal. The chiefs of our great fire offices have acted with wisdom and moderation in the past. There are often supreme difficulties besetting their path of which we know little, and while those who are engaged in administering tariffs, and in the practical working of

the business, should not shrink from pointing out inconsistencies and anomalies, or advocating such reforms as may be deemed indispensable to equitable and scientific results, yet it must at the same time be loyally and frankly conceded that the chief officers of companies, as represented in the Fire Offices Committee, are in the best position to form a sound and reliable judgment as to the proper time for introducing such reforms and changes as may be necessary in the practice of the business.

DAVID L. LAIDLAW.

Insurance and Actuarial Society of Glasgow,
13*th November*, 1899.

FIRE INSURANCE.

In acknowledging the honour conferred on a retired member of the Insurance profession by his being invited to address so important a Branch of it on a subject with which many of them are familiar, I may recall the fact that in the year 1872 I read a paper on Fire Insurance to the Actuarial Society of Edinburgh, which has been long out of print, and afterwards made some use of that paper when asked by the editors of the Encyclopædia Britannica to contribute an article on this subject. Many changes have occurred since then, and several very able and useful papers on various departments of the subject have been read to this Society and published in their Transactions; and I need scarcely recall the opening address of your honoured President* this session, which dealt so exhaustively with the progress and prospects of Fire Insurance as a science. The subject, however, is large and almost inexhaustible, and I shall now attempt, as I did in 1872, to give as general and comprehensive a view of this department of business as I can, bringing as far as possible some of the facts up to date, and endeavouring to recall what my own experience has since suggested to me, and making use of what I may have learnt from the writings and from the talk of others, like your President, more intimately acquainted with the subject. I will naturally have to give expression to many facts and views familiar to all of us, but I am not without hope that it is those who know a subject best who will be most ready to bear with, if not to welcome, any attempt to give a general view of it.

Fire Insurance, I do not hesitate to say, is a department of business which presents a greater number and variety of points of interest than almost any other. In the first place, it deals with and aims at counteracting to some extent the influence of one of the most powerful forces of nature, at once necessary and bene-

* *See ante*, p. 293.

ficent, and yet capable of inflicting any amount of injury and loss. It offers a benefit to every man having an interest in property capable of being injured or destroyed by fire, and that this is not confined to persons in the direct possession of such property may be shown hereafter. Of the persons engaged in this business it demands much scientific and technical knowledge, and no small administrative capacity; and, lastly, it is represented by numerous powerful, wealthy, and for the most part successful institutions existing in almost every civilised country throughout the world.

Something will fall to be said on each of these subjects, but from our point of view we may regard the last of them as the centre from which the others may be looked at. Let us begin, then, with the subject of Fire Insurance Companies. These have had a comparatively recent origin. It was not till after the great fire in London in 1666 that any systematic provision was made in this country for protecting the owners of property from loss by fire. This seems at first to have been done in the form of underwriting by individuals or by clubs, and some attempts were made to engage the Corporation of London in a scheme of Fire Insurance; but in 1681 the first regular office for insuring against loss by fire was opened by a combination of persons described as "at the back of the Royal Exchange," and it was followed shortly by another. Of the offices now existing, the oldest, the Hand-in-Hand, dates from 1696; five date from the first half of the 18th century, and three from the second half. The first Fire Office in Scotland was established in 1720; the first in Germany in 1750; the first in the United States was established at Philadelphia in 1752, and had Benjamin Franklin as one of its early directors; the first in France dates from 1816, and the first in Russia from 1827.

The business of Fire Insurance did not in this country receive much encouragement from Government. So early as in 1694 a stamp duty was imposed on fire policies, and in 1782, during the administration of Lord North, fire insurances were made liable to an annual duty of 1s. 6d. for every £100 insured, this rate having been increased in 1797 to 2s., in 1805 to 2s. 6d., in 1816 to 3s., at which rate it continued for about fifty years. It expired finally in 1869. It was easily collected by the offices along with their own premiums, in return for a small commission on the amount, and it yielded at one time to Government nearly two millions a year. Some descriptions of property, such as agricultural produce,

were exempt from this duty, and it only applied to property within the United Kingdom, but the records of this tax enable us to trace the progress of Fire Insurance within the United Kingdom during the 85 years of its incidence. The amounts insured on which duty was paid were—

In 1783 about	£135,000,000.	In 1840 about	£645,000,000.
In 1800 „	200,000,000.	In 1860 „	1,000,000,000.
In 1820 „	427,000,000.	In 1868 „	1,430,000,000.

The facts publicly known to us as to the more recent progress of the business in this country do not admit of direct comparison with those just mentioned. The published accounts of the companies do not usually state the sums insured, but only the premiums received, after deducting what has been paid for re-insurance, and they seldom distinguish between premiums received for property within the United Kingdom and the very considerable amount drawn from other countries; but the following figures may be given as affording information nearly up to date. The number of British offices at the present time appears to be about 60, including a few small establishments belonging to certain trades and some ecclesiastical bodies. The yearly premiums received in one year by these 60 offices, according to the figures in the Post Magazine Almanack for 1899, amounted to £19,185,780.* The corresponding income in the year 1888 seems to have been about £12,666,000, so that the increase in 10 years was 50 per cent. It need scarcely be stated that this increase may have been affected by at least three independent causes—the increase in the quantity or value of insurable property within the kingdom, the extension of business in the colonies and foreign countries, and the rise and fall of rates of premium.

A slight calculation will give us the economic value of these figures. It is difficult to tell with precision the average rate of premium which has gone to make up these 19 millions, but taking it at 5s. per cent., which cannot be far from the truth, we arrive at the conclusion that British offices alone are protecting the owners of property capable of being injured by fire to the extent of nearly eight thousand millions sterling, but probably worth a much larger sum, property being seldom insured up to its full value. In the Continent of Europe there are considerably more than 200 Fire Insurance offices, and in the United States the number of native offices is large. This will give some idea of

* "Fire and Water" gives the amount for 1898 for 52 tariff offices as £19,343,000.

the estimate that may be formed of the value of the property threatened by the demon of Fire. The extent of his assaults may be illustrated by one or two sets of figures. Thus, the number of fires which occurred in London alone in 1898 is reported to have been 3585, which, however, was above the average of previous years. The losses by fire in one year paid for by British offices have been about 11½ millions sterling, while in the United States and Canada recent losses have been at the yearly rate of about 130 millions of dollars or 26 millions sterling. As to the number of persons interested, we may recall the possible effects of the destruction of one large factory or warehouse, held, let us suppose, by a joint stock company. Uninsured, the loss will fall on numerous shareholders, possibly on creditors, and on the men who will be driven out of work by the loss of the buildings, the machinery, and the materials which went to support the industry. On the other hand, it is hard to reckon how many will benefit by the fresh capital supplied by the Insurance companies to provide the materials, the skill, and the labour which go to secure continued employment.

The figures that have been given afford some indication of the magnitude of the subject with which we are dealing, but Fire Insurance, after all, forms only one department of a much larger business. It is often in practice closely associated with Life Assurance, and their union as a matter of business is not unattended with some advantages. Insurance generally may be defined as a species of machinery for protecting men from some of the consequences of accidents to which they are liable. The fundamental element of Life Assurance is the protection of a man's family, his creditors, or others to whom his life has a pecuniary value against the loss they may suffer by his premature death. Marine Insurance protects the persons interested in a ship or its cargo from the pecuniary consequences of loss or damage happening to it. There has been in comparatively recent years a development of various minor forms of Insurance business, some of them at once useful and successful, while the fate of others has shown, as might have been, and indeed was predicted, that there are pecuniary risks to which the principle is inapplicable.*

* In a previous address on the "Economics of Insurance," read to this Society in 1888, I ventured to show reasons for doubting whether the principle of insurance could be applied to protection against possible loss by investments. Ther has been since then ample evidence that these doubts were well founded.

The essential principle of all legitimate Insurance business is the distribution of loss. Fire Insurance, for example, does not aim, directly at least, at the prevention of fires, and only deals in a secondary way even with the minimising of the risk of fire. What it aims at is that since, in spite of every precaution that can be taken, it is certain that the accident of fire will frequently occur, and valuable property be injured or destroyed, the loss shall not fall exclusively, and possibly with ruinous effect, on the owner of that property, but shall be borne in easy proportions by a large number of persons who are all alike exposed to the risk of a similar catastrophe, and who are ready for their own sakes to assist in providing the necessary funds. This work of distribution is capable of being effected in more ways than one. In a few cases in other countries it has been undertaken by the State or by a municipality, but this plan is attended with considerable difficulty. It has been found possible in a few cases for the owners of certain descriptions of property to apply the principle of mutual insurance. But, on the whole, it is beyond question that the most effective security, and on the most fair and reasonable terms, is to be had through the machinery of joint stock enterprise, backed by the necessary capital, and the equally needed knowledge and technical skill.

If Insurance of any kind is to be undertaken as a matter of reasonable business, and not as a wild speculation amounting to gambling, it is necessary that there shall be some means of measuring and putting a limit on the risk to be undertaken; and that every consideration shall be given beforehand, and given with some capacity and singleness of aim, to the conditions of the problem. It will help us to understand these if we compare for a moment the elements of risk in Life and in Fire Insurance. In the former the risks to be undertaken may be measured with a certainty to which the other is a stranger. This certainty arises chiefly from three causes—first, from the small number of elements involved, there being, in fact, but two that are essential, namely, the rate of mortality and the rate of interest; secondly, from the fact, established beyond all question, that laws of mortality do exist and may be reckoned on; and, thirdly, from the eminent success which has attended the investigation of these laws, and the application of mathematical and medical science and common observation to the problems falling to be dealt with. Although the rate of interest to be reckoned on for long periods of years is

an element of some uncertainty, as we have all felt strongly in recent years, and calls for much prudent consideration, the possible changes are not unlimited and may be provided for. The only other thing which enters into the calculation is the rate of expense, and this is to some extent within the control of the conductors of the business. It is obviously possible therefore to undertake Life Assurance with entire prudence, notwithstanding that its engagements extend over long periods of future years and do not admit of modification.

Fire Insurance has none of these elements of certainty. All experience shows that the chances of the occurrence of fire and the measure of its intensity are liable to great variations, and are often governed by causes which it is impossible to anticipate or to restrict. Much ingenuity and many curious statistics have been adduced to show that events which we are accustomed to regard as purely accidental must be governed by some law, and that their recurrence in the same proportions or in the same sequence may be confidently looked for. Thus, it is said that the number of letters posted without an address, and even the aggregate amount of money which such letters are found to contain, may be pretty confidently reckoned upon. But, if fires could be supposed to be subject to any law of recurrence, it has not been ascertained or formulated so as to be of any use. An ingenious paper, indeed, was read to the Institute of Actuaries in 1880, suggesting a mode of framing algebraic formulæ for the rates of premium that may be required for certain descriptions of property. But it is one thing to find a scientific expression for known and measurable quantities, and quite another to ascertain and to measure all the risks we have practically to deal with, and the innumerable varieties of circumstance which tend to modify them. The recognisable causes of fire have been subject to many changes within our own recollection. Among such variable causes are the magnitude of factories and warehouses, and the crowding together of valuable property, the increase in power and rapidity of machinery, and the invention of new machines and new chemical combinations, new means of transport and new plans of storage. Many of these changes, though not all of them, have increased the risk of damage by fire; while, on the other hand, improved methods of building and improved means of preventing and extinguishing fires have operated in the other direction. Then there is the very important

element known as moral hazard, which does not mean merely the greater or less chance of wilful fire-raising, but is probably more influential in the direction of causing greater or less care among the owners and custodiers of property for the prevention and the extinction of fires. In Britain there is probably less attention paid to this class of hazards than in some other countries, but that they exist and are liable to change is certain. I remember in a great manufacturing city a partner in one of the leading firms complained to me that Insurance companies did not adapt their rates to the real differences in the risks they ran; and, being pressed for an explanation, he hinted that the financial condition of a manufacturer might make a difference in the degree of his reluctance to have a fire in his premises, and consequently in the care taken to prevent such a catastrophe. But he came to see how impossible it would be to measure this risk, or even to suggest it to the parties concerned, and that where it was believed to exist the course to be pursued was not to increase the rate but to decline any transaction. In New England I was informed of a mutual insurance arrangement which existed among a certain class of mill-owners, with the result that their average losses were greatly less than what are experienced in this country among the same description of factories; one of the causes being that the association was limited to persons who had entire confidence in each other.

The risks to be run by a Fire Insurance company being so uncertain and so variable, it might seem to be too hazardous a description of business to be undertaken by men of ordinary prudence; but it possesses an element of safety which does not belong to Life Assurance, and which in a large degree makes up for these uncertainties. This consists in the fact that, in this country at all events, very few Fire Insurance contracts are made for more than a year, and many for even shorter periods; so that ample opportunity is given for revising their terms from time to time, or for terminating them altogether, if either course should prove to be necessary. Neither Fire nor Life Insurance need ever prove unprofitable in the long run, although both may no doubt be mismanaged; but in Fire Insurance mismanagement is followed by its punishment with a happy rapidity which ought to prevent any very fatal accumulation of mischief. The errors arising from an imperfect experience or a too sanguine generalisation are capable of being corrected almost

from day to day. While the Life office, treading on the firm ground of well-determined laws, steps out boldly and undertakes engagements which may bind it for half a century, the prudent Fire office creeps along from year to year feeling its way, watching the ever-varying contingencies which affect it, raising and lowering its rates as growing experience dictates, and, having to deal with hazards which it can measure very imperfectly, it so deals with them as to attain a high degree of safety, not greater than that of well-directed Life Assurance, but certainly not less.

One temptation besets almost all the parties connected with Insurance business which is apt to have unfavourable effects without much delay in the case of a Fire office. At the present day there is a somewhat unhealthy craving for magnitude in almost all departments of business, and the persons in the employment of a joint stock company are apt to be valued and paid in proportion to the amount of their transactions. In Fire Insurance the premiums received are a conspicuous and measurable benefit, while as to the losses which are to follow there is room for any amount of sanguine hope; and when they do come, they have all the appearance of being purely accidental. And so they may be, but all the same they might often have been avoided, if in the selection of the business to be done, in the rates to be charged, and in the price to be paid to agents and others, safety rather than quantity had been most in view. It is sometimes suggested that a small percentage of profits on a large business may be more advantageous than a larger percentage on a smaller business; but the smaller percentage makes a nearer approach to the stage at which profits disappear altogether, and the larger the business the more room there is for unexpected variations in the nature and degree of the risks undertaken.

A very small business, on the other hand, especially if, as sometimes happens, it is limited to one description of property, has its own dangers. Owners of property who wish to be perfectly secure will probably avoid extremes. Of the British offices, in number about 60, as has already been mentioned, there are 31 whose incomes from premiums exceed in each case £100,000. Of these there are 23 which have a reserve fund, over and above their capital, exceeding one year's income, while the corresponding reserve of the other eight is less than one year's income. The income of the 23 is 16 millions, while their reserve is 24¾ millions. The income of the eight is nearly 2½ millions, while their

reserve does not much exceed one million. In the one case the average reserve is equal to 154 per cent. of income, in the other only 42 per cent. As an illustration of what may be done with a business of moderate income, it may be mentioned that four companies have an income between £50,000 and £100,000, or together £293,276, and have a reserve of £477,803, equal to 160 per cent. of their yearly income.

In considering what amount of reserve is necessary it has to be kept in view that the published accounts of Fire Insurance companies do not usually provide for what may be described as unexpired risk. When a policy has been opened or renewed at the Scotch quarterly term of Martinmas (11th November) one year's premium appears among the company's funds, but the risk has still to be run under that policy for nearly ten months. If Christmas is the commencing term almost a whole year's risk has to be provided for. In America policies are often issued for three or five years, and the premiums received and forming part of the company's assets have to meet in these cases the possible losses of several years. But, taking the bulk of British business, it is probably a reasonably safe assumption that one-third of the premiums received in one year will be required to provide for the unexpired risks. In tracing the history of a company it has to be kept in view that if any material increase takes place in its premium income a corresponding increase is needed on its reserve. In one sense, that reserve which every company ought to possess to meet unexpected and extraordinary losses, only begins after the unexpired risks have been provided for.

In connection with this very important department of our subject, it is desirable to look frankly at one element in the conduct of Fire Insurance business. Every company engaged in this business, like all other joint stock companies, is under the control of a Board of Directors. Directors often bring to bear on the business they are controlling an amount and a variety of knowledge and capacity which are invaluable, and in some departments familiar to most of us, such as the investment of funds, their united judgment will be acknowledged to be often of greater value than the advice of the most capable manager. But Fire Insurance is a business so technical and so complicated that few, if any, of the gentlemen who act as directors in that business will claim to have any great knowledge of it, and in what measure of control they exercise they will be very dependent on

the information and advice of their officers. I know of one manager who, finding that some of his directors felt that they were very ignorant of the business for which they were responsible, invited them to look into its details. He tried to carry them through the history of one transaction, involving the numerous considerations which will be afterwards adverted to (page 343). I believe they were greatly interested; but one conclusion seemed to be generally adopted, viz., that they needed to place absolute confidence in their officers, and that any attempt to interfere with them would probably do more harm than good.

This state of matters points to a very serious responsibility on the part of those who are entrusted with the details of this business, from the manager down to the youngest clerk. And as regards the managers at the head office and at branches, the responsibility is not limited to details, but embraces the advice to be given on the principles which ought to regulate the business. The financial importance of this will be appreciated when it is kept in view that in 1898 52 British offices, with an income of upwards of 19 millions, paid away 60 per cent. of that amount in losses and nearly 35 per cent. in expenses, and only retained a little over 5 per cent. for themselves. An increase or a decrease of no more than one per cent. would have made a difference of nearly £200,000. One principle in the management of such a business is apt to be disregarded—viz., that in its influence on profits quality of business is of more importance than quantity; that selection, adequate rating, and economy in expenditure, may tell more on the results than mere magnitude.

While it is of the utmost importance to the owners of property that the companies which insure them should be solvent and entirely trustworthy, it remains an unquestionable fact that all losses by fire are ultimately borne by the owners themselves as an aggregate. The business of the companies is to distribute the loss. A familiar illustration of this truth may be referred to. One of our oldest Fire offices is accustomed to advertise the amount it has paid for losses. Some 30 years ago the sum was stated to be nine millions; to-day it has risen to 22 millions, and yet the capital originally contributed by the shareholders, which was less than £300,000, is now represented by a sum at their credit of a million and a half. Obviously, therefore, the 22 millions of losses have not been paid out of its own funds; it has merely been the medium by which they have been gathered and

distributed. And upon the public, that is, upon the owners of insurable property, has fallen also the whole expense of this organised machinery, as well as some return for the use of the capital employed and the risks incurred. Let us see what would be the consequences if the public did not bear these burdens. The funds of the Insurance companies, large as they are, would gradually melt away, and if no remedy were found these companies, with the benefits which they confer on the public, would cease to exist. But long before that happened they would find the means of protecting themselves by simply refusing to renew their contracts except at greatly increased rates. Practically all prudent offices, and these alone are likely to have a continued life, endeavour to adjust their rates of charge to the amount of the claims and other outlay which they have to meet; and any community which permits many fires to occur within its bounds, by failing to guard against them, has in the end to repay to the Offices in the shape of increased rates the losses they have incurred. How this is arranged will be afterwards referred to.

It follows from this that it is for the owners of property and not for the Insurance offices to be at the trouble and expense of keeping down fires. This has not always been recognised, and even yet attempts are often made to lay on the companies the cost of keeping up fire-engines. In former days, before attention had been given to the duty lying on public administration of guarding life and property against the inroads of fire, and before the development of that happy mixture of competition and combination among the Insurance offices, which will presently be referred to, each Insurance company had a fire-engine of its own in towns where its business was of magnitude, and often had the walls of buildings insured with it marked with its name. In the "Rejected Addresses" the appearance of the fire-engines at the burning of Drury Lane Theatre is playfully supposed to be thus described by Scott:—

> "The Hand-in-Hand the race begun,
> Next came the Phœnix and the Sun,
> The Exchange where old insurers run,
> The Eagle where the new."

In London the offices ultimately associated together to keep up a great fire-engine establishment, and it was only in 1866 that they got rid of this responsibility by handing it over to the care

of the Metropolitan Board, while they continue to contribute towards its support. In 1897, 67 British and foreign offices contributed £31,348 for this object, being at the rate of £35 for every million insured by them. The aggregate amount insured on property within the Metropolitan district was 895 millions. There are still perhaps one or two provincial towns where offices keep up engines of their own; but in most places of importance the local authorities keep up a fire-engine establishment, the expense of which is borne by the rates. In a very few cases local Acts of Parliament still subsist which confer a power of assessing the Insurance offices or making a charge on the owners of property where a fire has called for the assistance of the public engines, which charge often falls on the Insurance offices. Attempts have been very common to obtain such powers or to procure voluntary contributions from the offices, but they have come deliberately to the conclusion that such attempts are to be strenuously resisted. Fire brigades will never be efficient if they are managed by one set of people and paid for by another, and the Insurance offices cannot pretend to have the machinery for managing such brigades in every town all over the world where these ought to exist. Although the rapid extinction of a fire may seem to interest first of all the office that insures the property, there can be no doubt that the keeping down of fires in any locality, apart from the protection of life, is directly a matter of pecuniary interest to the inhabitants. If this is done effectually, a reduction in the cost of protecting themselves by insurance is sure to follow, or at all events it will be prevented from rising. Insurance offices have no desire to levy high rates of premium; they greatly prefer that risks and rates should both be kept down. But it is not their business to extinguish fires; it is for them to measure the risk they run and to charge for it according to its magnitude. It is to be kept in view also that a prevalence of fires occasions many evils with which Insurance offices have no concern, and which it is for the owners of property to guard against. The loss to the merchant or the manufacturer whose business is brought to a standstill, to the house-owner who sees his home and its irreplaceable contents destroyed, the horrors felt by neighbours, the risk to life, &c., are all things that obviously call on the inhabitants to organise for themselves some protection. The mere pecuniary loss, if it is increased by want of attention to protective measures, the Insur-

ance offices can and will provide for by adequate rates of premium. What interest they have in the keeping down of fires, while it looks very conspicuous, is really a secondary matter. But the Offices have conferred a great benefit on the owners of property by some of the measures they have taken which tend to lessen the risk of fire. In comparatively recent times, for example, there has been a growth of attention to the inspection of properties offered for insurance, and to the application of scientific knowledge to their condition as affecting their liability to destruction by fire; and occasionally repeated inspections have been found very useful. Then the establishment of what are known as salvage corps has been a valuable step; that is the employment of a body of men to act at a fire directly in the interests of the Insurance offices, whose immediate duty is not so much to extinguish the fire as to lessen the destruction of property. Some attempts have been made to introduce the holding of a public enquiry as to the cause and history of a fire, which would often throw much light on the questions as to how fires may be prevented or mitigated. It may be difficult to measure exactly the degree of benefit conferred by any of these proceedings on the Insurance offices and the public respectively, but the matter will be better understood when we come, as we now do, to consider the problem of the system of rating and the variety of risk.

Fire Insurance, being the machinery for distributing losses by fire, aims at doing this with discrimination. It creates, as it were, a common fund out of which these losses will be made good, and each owner of insured property contributes to this fund; but it is only reasonable that each contribution should bear some proportion to the degree of risk which it brings with it. That some descriptions of property should be more liable to destruction by fire than others is obvious, and has become matter of ample experience; and the first great business of Insurance offices is to try to measure this risk. In this country long experience has shown that while with large classes of property an annual payment at the rate of 1s. 6d. per cent. will usually provide for all losses as well as for the cost of working the business, the corresponding payment which will be required by other sorts of property may rise as high as £7 7s. per cent. The risk of loss by fire is affected by innumerable circumstances. There are, in the first place, the chances of fire occurring; then the chances of its spreading, or, in other words, the greater or less likelihood of its being speedily

extinguished; the chances of damage by water and by smoke; and the greater or less prospect of salvage. One or all of these chances will depend on the structure of the building which is insured, or which contains the goods insured, the materials of which it is composed, and the mode in which it is lighted and heated. In the next place, the contents of the building have to be considered, whether they are liable to catch fire readily or are capable of spontaneous combustion; and in this connection it has often to be had in view that two sorts of goods, neither of them very hazardous in themselves, such as oil and wool, may become extremely dangerous when brought together; and, indeed, as the addition of oil, and even of water, to certain kinds of goods will often cause them to take fire, their liability to this admixture has to be looked to. Then there are the manufacturing processes carried on, which involve great diversity of risk and of corresponding rates of premium. Lastly, there have to be considered what are known as moral hazards (already adverted to), and these are liable to vary from time to time, and to be more prominent in some countries than in others.

If the owners of any description of property are to pay for the protection afforded to them by insurance in some proportion to the risk incurred by them, it is of the highest importance to them and to the public generally, and to the Insurance offices, that that risk should be measured with as much correctness as possible. It might be supposed that, in conformity with the experience of other departments of business, competition might be left to fix the price at which the needed protection was to be obtained; but this is a business which has some very exceptional features. When goods manufactured or imported are sold, the seller knows what they have cost him before he has to fix his price; and, while there may be room for competition in limiting the cost of production or the ratio of expected profit, no man need carry on a business unless it is pretty certain to yield him a profit. But in Fire Insurance the price has to be fixed in the first place and the cost comes afterwards; and unrestrained competition might mean that the price would be fixed by the most sanguine, the most ignorant, and the most speculative of the competitors, and would certainly land them all in loss. This would probably be quite as injurious to the owners of property as to the offices, for it is of the utmost importance to the public that they should have a reasonable number of wealthy, prosperous, and therefore safe

offices with which to insure their property. And if different classes of property are to be insured at fair rates corresponding to the risk, this could scarcely be attained if each office were to be guided only by its own limited experience.

Accordingly, it has been found in most countries that these objects can only be secured by the offices combining their experience and agreeing upon a scale of rates founded on this. This is known among us as the tariff system, and experience has fully established the practicableness of such a system and the benefits which the offices and the public derive from it. An association having these ends in view existed in Scotland long before any definite arrangement of the same kind was adopted in England or probably in any other country. The earliest records of the Scottish Association date from the year 1829. The English offices had a good deal of private communication with each other and occasional meetings, but no formal organisation until the year 1858. In that year it was arranged that all the offices in the United Kingdom, or at least as many as pleased, should join an association. They possess a central establishment in London, where their representatives hold frequent meetings. These meetings serve other important purposes besides the fixing of rates, some of which may be afterwards considered.

The main object is to secure adequate rates of premium. This is promoted by two methods—by an agreement as to what shall be the minimum rates to be charged for various descriptions of property, and by affixing in the form of increased rates such a penalty on dangerous constructions, substances, and processes as to induce if possible a lessening of the danger. In other words, and reversing the order, the organisation seeks to diminish the risk of fire and to secure the necessary payment for what risk remains. There can be no doubt as to the benefits which the public derive from the former of these. To have pointed out to them, not on the authority of one office, still less on hesitating and contradictory authority, but with all the weight arising from the combined experience of numerous companies, that this or that method of construction, this or that combination of substances, this or that mode of conducting a manufacturing process is attended by imminent hazard of fire which is capable of being avoided or mitigated, and to have the lesson enforced by a heavy pecuniary penalty, ought to be of advantage to those who, more

intent perhaps on other objects than on the avoiding of this particular risk, must yet in the end suffer from the prevalence of fires, and must, as we have seen, bear the burden of all fires. That very great benefit has accrued to the public from this function of the combined offices admits of many illustrations. Many years ago an increase of rates following heavy losses drew the attention of the merchants of Liverpool to the defective condition and management of warehouses in that great entrepot. An Act of Parliament was procured for their better regulation, and the result was an early return to reduced rates of insurance, and an avoidance of those secondary losses and inconveniences arising from fires against which no insurance can afford entire protection. At a subsequent period it was discovered that many fires in Dundee arose from the doors and windows of flax warehouses being so imperfectly constructed that evil-disposed persons could and did set fire to the loose flax which was cropping out into the public ways, and which conveyed the fire to the whole contents of the warehouse. The offices as a body required all doors and windows of flax warehouses within fifteen feet of the ground to be carefully guarded by sheet iron. At some expense the regulation was universally complied with, and although there was some grumbling at first it was soon acknowledged by the merchants themselves that a great improvement had been established. What the offices did was to charge an additional rate when the required alteration was not effected. The increased rate became a nullity so far as yielding any additional income to the offices, but it lessened the risk of fire, and this, largely in the interests of the insured, was the object aimed at.

In many complicated processes of manufacture, flax or cotton or wool spinning, for example, there are parts of the process peculiarly hazardous as regards fire. In particular, the first treatment of the raw material is generally attended with this greater risk. The rough and dirty substance has to be smoothed and cleaned, and one common method is to pass it through machines, bearing different names, where it is subjected to the action of steel teeth revolving with prodigious velocity. The loose dust and small particles of fibre thrown off in this process create a highly inflammable atmosphere, while any fragment of stone or iron which may by accident have got amongst the material will strike against the teeth of the machine and create a spark of fire. The existence of such a process in the heart of a

mill adds, of course, greatly to the risk of its being burned. A high rate charged where such a machine exists induces manufacturers to place it in some detached building where any fire it may occasion will have litle chance of spreading. A good many years ago attention was directed to another source of danger—the use of oil in lubricating machinery and the nature of the oil employed. I remember when, on behalf of the Scottish offices, I had occasion to receive from the dealers many specimens of oils to be tested as to their tendency to give off an inflammable vapour, and for a time a warranty was instituted against the use of mineral oils, but it was found impossible to enforce it, as mineral oils were freely sold under other designations. On the other hand, encouragement has been given by reduction of rate to the use of sprinklers or other means of preventing and stopping fires. These are only a few illustrations of what has been aimed at. On the supposition that the offices are correct in the estimate they form of certain elements of risk, the effect, and indeed the intention of their rules, is not so much to put money into their own coffers as to lessen the risk, and so to save themselves in the first instance, and the owners of property ultimately, from the consequences of preventible fires.

These rules, as will readily be seen, must have powerful influences on trade and manufactures. Many individual warehouses and factories are, with their contents, insured for very large sums—£10,000, £20,000, £50,000, £100,000, and more. An additional charge of 5s. or 10s. per cent. in respect of some supposed increase of risk may mean a payment by the owner of several hundred pounds a year, and may operate as a complete veto on some arrangement or some machine which it might otherwise be desirable to resort to. The occurrence of a few severe fires in one seaport town, followed by an increase of insurance rates, may have, and I believe has had, the effect of driving some branch of trade away to other localities—the seats of greater caution. It is therefore obviously desirable that so important an influence should be exercised, not precariously or capriciously, but according to the combined wisdom and experience of those establishments which may be supposed to understand the subject best, and to obtain their experience in the way which makes it perhaps of most value, by paying for it.

While the combined action of the offices is thus fitted to benefit both themselves and the public, it is beyond question that no

association of the kind will ever hold together a large body of independent and powerful companies except under the pressure of some necessity. No conventional or excessive rates can be maintained for any length of time. Some member of the union is sure to perceive that popularity and profit may be gained by introducing a lower rate, if a lower rate is manifestly sufficient, or a new company starts into existence to remedy the grievance. It may be assumed, too, that directors and others interested in a company are also among the insured, and may be quick to raise the question of how far the rates they have to pay as individuals are a true measure of the risk. The associations we are considering are unions bound together by necessity tempered by competition. The wonder is that the competitive spirit and the personal interests of many of those who are engaged in the business do not lead more frequently to breaches of the understandings on which the union is based. It will sometimes happen that an office loses some business by being undersold by another which ought to have charged the same rate. This may be caused by the overzeal of subordinates; but if that were always discouraged at headquarters, as it ought to be, it would not occur often.

Before leaving this subject of the united action of the offices, something falls to be said of another important object which it deals with—the system of re-insurance. An obvious element of prudence in the management of Insurance business in all its departments is not to expose a company to the risk of an excessive amount of loss by any one accident. This has specially to be attended to in Fire Insurance, for not only may very large amounts be at risk under one roof, but as fires are apt to spread from one building to another, too large an amount of risk in one neighbourhood has to be guarded against. At the same time, it is often of importance to the persons who have large amounts to insure to be able to make their arrangements with one office. Hence it has long been the practice for an office which has to undertake a larger risk than it would be prudent to retain, whether in Life or Fire or Marine Insurance, to re-insure a portion of individual risks with one or more of its fellows, at once friends and rivals, who in return for a share of the premium engage to pay a corresponding proportion of any loss, and also to reciprocate with similar contributions of business. This has come to be a very large department of Insurance business, involving many considerations calling for attention.

But apart from these arrangements, it often happens that two or more offices have a common interest in certain risks and in the settlement of losses when they occur. The goods in a warehouse may belong to several owners who may have them insured with different offices, or the very same goods may be insnred in more than one office by the owner, by the custodier, or by persons having some other pecuniary interest in them. The same building may be insured by its owner with one office, and by one or more mortgagees with others. In short, Fire Insurance offers, to a peculiar extent, occasion for intercourse between the parties engaged in it, for frequent questions arising as to their several rights and obligations, and for efforts to arrive at a common understanding on these subjects. The Scottish Association adopted at an early date a definite code of laws to regulate the reinsurance business transacted by the companies with each other, and many years ago I had the privilege of assisting in the revision of these laws. Afterwards, when the English offices resolved on similar arrangements, I had occasion to represent the Scottish offices as one of a small committee which met at Liverpool, when, though not without some hesitation, the Scottish rules were made the basis of a general code. One important feature of this code is the provision for submitting to arbitration any questions arising between one office and another. A board of referees is elected annually, and while offices may, and often do, select their own arbiters, and while the obligation to refer cannot be enforced in every case, the system as a whole has worked admirably. One curious effect of it has been that on many important questions that are apt to arise there is very little legal authority to be found, simply because the offices have been able, as they have been very desirous, to avoid formal litigation. The frequent meetings and personal intercourse, the value to each of the men engaged in this work of the information and the counsel obtained from the others, the opportunities afforded of intimate acquaintance and friendship with men whom we could not fail to respect for their mastery of their business and other qualities, has made this and other similar associations a source of individual happiness, and an important mitigation of the labours and anxieties of ordinary business life.

Returning to those aspects of the business which affect individual offices, we may look at the nature of the Fire Insurance

contract. An Insurance policy is essentially a contract, as it embodies and gives effect to obligations on both sides. Limiting ourselves to Fire Insurance, it is an obvious condition that the fire to be provided for shall not be brought about directly by the action of the insured. Then it is a condition that the property to be insured shall be correctly described by the owner, and that all exceptional elements of risk shall be disclosed, and that nothing of this sort shall be introduced without the knowledge and expressed consent of the company. What is aimed at is that the degree of risk involved shall be fully understood on both sides, and that any loss to be claimed for shall be purely accidental so far as the insured is concerned, and that the contract shall be one of absolute good faith. It may be mentioned, however, that the policy protects the insured against the effects of carelessness or misconduct on the part of his own employés so long as he has had no part in it. What the policy does for the owner of property injured by fire is to provide indemnity against loss. In Life Insurance, although the main consideration probably is protection to a man's family or others against pecuniary loss occasioned by his death, that is not an essential condition of the contract. One of the many uses of Life Assurance is to provide a safe and convenient system of saving, and a man may legitimately assure his life even when those who are to receive the money may benefit otherwise by his death rather than suffer loss. In Fire Insurance the insured cannot, or at least ought not, to make a profit by a fire except through fraud or error. This arises not more from the terms of the policy than from settled principles of law, and these are largely founded on the consideration that the possibility of obtaining through a fire more than has been lost would inevitably increase the number of fires, partly by leading to incendiarism, but chiefly perhaps by encouraging careless and dangerous practices. An effect of this kind has been the acknowledged consequence of a different rule in Marine Insurance.

Other principles affecting the obligations undertaken in a Fire policy may be referred to. The loss must be genuine, but it must also affect directly or indirectly the person insured. He must either be the owner of the property, or the custodier with liability, or a trustee for the person really interested. Then he cannot recover more than the actual value of the property at the moment of the fire. Whatever may be the amount of the policy it is not the measure but the limit of his claim. It is only for the diminution in value caused directly by the fire that any claim exists.

Some interesting consequences flow from the last-mentioned rule. The owner of a house or furniture which is worth £1000 may insure it for that sum and go on paying premiums for twenty years. At the end of that time it is burned, and he is perhaps disappointed to find that he does not necessarily recover £1000, but only perhaps the smaller sum—possibly much smaller—which is the measure of its value at the date of the fire. It may be very inconvenient; the old house or the old furniture suited him perhaps just as well as the new will do, but he has to replace it with a new house or furniture, and as that may be of greater pecuniary value than the old he will have to provide part of the cost in addition to what he receives under his policy. But the insurance is against damage done by fire only, not against the deterioration of value by use and time, not against tear and wear as it is called. On the same principle, if you have bought a parcel of goods—grain, for instance—and the price of it falls in the market, you cannot, in the event of a fire, claim for what it costs you, but only for its market value at the date of the fire. Many curious cases have occurred within my own experience in connection with these questions. During the Civil War in America there was a great rise in the price of cotton, and importers naturally insured their cargoes for what they had cost them. Peace came, and a sudden fall in market value, and a consequent loss to the importers, from which the occurrence of a fire would have happily relieved them if the sum insured was to be the measure of their relief, but that would have amounted to an insurance not merely against fire but against the fluctuations of the market. Illustrations of the difference there might be between cost and present value frequently occur. About fifty years ago a fire occurred in the premises of a printer where many stereotype plates of an edition of the Waverley Novels were destroyed. These plates had been so frequently used that they had lost much of their value, but the full cost of setting up the types anew and casting new plates was claimed, and the question being referred to a public man, who, as it happened, was also a distinguished publisher, was decided against the Insurance Company. On another occasion some hundreds of copies of a certain book were destroyed in the premises of another publisher, and the full price was claimed for them. The question suggested itself whether volumes published some years before, and which had lain unsold in the meantime, involved a greater loss than if they were waste

paper, and whether the owner was entitled, through the accident of a fire, to receive the same price as if the whole quantity had been sold off-hand. In that case the directors of the company took a view more liberal than perhaps was politic, and admitted the claim. On the other hand, some years ago the books forming Sir Walter Scott's library at Abbotsford were insured, and the offices agreed that in the event of their being burned they should be paid for at a rate largely in excess of the shop price of similar volumes, it being recognised that the fact of their having been Sir W. Scott's books gave them an exceptional market value. The alterations that often take place in the value of pictures afford another illustration. I remember the case of a wealthy collector who had paid several thousand pounds for an ancient picture being warned by an accomplished friend that it was not a genuine work of the artist, but a copy. Inquiries having been made through the eminent dealer from whom the picture had been bought, and who had himself been deceived, it was found that the picture was a copy, and was worth a comparatively small sum, and the large price paid for it was returned to the purchaser. If the picture had been burned before this discovery the Insurance Company would certainly have been entitled to inquire into the question of its real value, the price paid in such a case not being an absolute criterion.

The only safeguard against a multiplication of fires is a strict enforcement of the rule that the insured shall never profit by a fire. The offices themselves are often the promoters of fires; for a liberal spirit, which desires when a loss has occurred to deal with it generously, and a competitive spirit, which desires to purchase favour by the reputation of liberality, lead sometimes to too easy settlements of claims, and these are apt to be provocative of future fires. Unmistakable instances of this have come under my own observation. On the other hand, a reasonable amount of strictness in adhering to legal obligations tells the other way. Some years ago, in one very large department of manufacturing industry, there was a marked diminution in the number of fires. On inquiring into the probable cause of this, I was informed, on authority not likely to be mistaken, that for some time past the offices had been more strict than previously in ascertaining the amount of any loss by fire, that fires had consequently been found less advantageous to the persons insured, and that greater care had been taken to avoid them.

As a fire can never legitimately prove advantageous to the insured, those who set fire to their property with a view to defrauding an Insurance company, unless they do it under an erroneous impression that they will receive the sum in the policy without having to prove the amount of their loss, are obliged to do more than merely burn their property: they must be prepared to prove that it was worth more than it was really worth. Accordingly, in most of the cases in which there is a suspicion of arson, the question, when it comes before a court of law or a jury, turns largely on the value of the property at the time of the fire. Perhaps the man has sent away or concealed his property, and yet claims for it as if it had been burned; or he produces false invoices, or he and his family or servants swear to the destruction of property which never existed. In one case which I had something to do with, the Offices concerned found themselves able to purchase at an auction in Paris a picture for the destruction of which they had been called upon to pay. In another case, in which many Offices were concerned, a somewhat remarkable man who dealt in pictures succeeded in defrauding one office after another by claims in which the same damaged works of art figured over and over again as the evidence of his loss. Being detected at last, while awaiting trial he committed suicide in prison, leaving behind him a MS. journal in which he had noted the details of each of his frauds, with many particulars of the various Insurance offices on which he had tried them, or still meant to try, even to the extent of describing the personal traits and apparent dispositions of the secretaries and surveyors whom it was his object to deceive.

One large and important principle in the nature of the protection afforded by Fire Insurance remains to be mentioned. Under ordinary policies in this country the insured may recover the whole amount of his loss provided it does not exceed the amount of the policy, even though he may have insured and paid premium for an amount far below its full value. If my property is worth £1000 and I insure it only for £500, I no doubt become partially my own insurer, and so run a certain risk; but the office bears the first brunt of any loss, and my risk only begins after their policy is exhausted. In some other countries, and in certain cases here also, the principle cf average is introduced, and it is made a condition that if the property is only partially insured any loss shall be paid for only in the like proportion. This rule is

applied in all cases where two or more separate buildings, or the contents of two or more buildings, are insured for a lump sum. As long as the Government duty lasted it was required by Act of Parliament that this should be the rule in every such case. With the repeal of these duties this law was repealed, but it is not the less universally acted on by the offices for their own protection and made a condition of their policies.

The application of this principle is extremely useful to some classes of insurers. A merchant may have a large cargo of foreign goods or produce consigned to him which he cannot get stored in one warehouse. Often he can scarcely tell for some little time in what warehouses it has found quarters and in what proportion, and in the meantime insurance is most necessary. A very common form of policy, known as a floating policy, is to insure the goods belonging to A, or perhaps the goods that have arrived by such and such a ship, in all or any of the warehouses in a certain town or district. The insurance may be limited to a certain class of warehouses which are known to be less hazardous than others, and are therefore insured at a lower rate. In the event of a fire the insurer has, of course, to show not only what he has lost in that warehouse, but what other goods he has covered by the same policy. If the value of these in the aggregate exceeds the sum insured then he can only recover a portion of his loss. The intention and effect of the system is to secure that the insured shall pay premiums in proportion to the whole value of their goods.

It need only further be mentioned in connection with the nature of the Insurance contract that it excepts from liability osses caused by invasion, foreign enemy, civil commotion, riot, or any military or usurped power; and there are some descriptions of property which are not insured, ready money, books of accounts (*i.e.*, their value as documents), bank-notes, stamps, bills, bonds, or other written securities. It is pretty obvious that a claim for such losses would scarcely admit of proof and might give rise to interminable questions.

Having thus attempted a sketch of the general principles of Fire Insurance, we may glance at some of the practical matters with which those who are engaged in this business have to deal. One way of doing this will be to follow out an individual transaction from its inception onwards. The importance to the owners of property capable of being injured by fire of obtaining

the protection of Insurance is so obvious and so urgent, that every such owner might be expected to seek it eagerly without any external influence. It is found, however, that it is very necessary to bring the subject continually under notice by advertisement and otherwise, but especially by the employment of agents engaged and paid to induce persons to insure. The competition of rival offices renders this, of course, more necessary. Accordingly, there is a large body of men of business who are induced to undertake this work. In America an Insurance agency is often regarded as a distinct occupation, to which a man's whole time may be dedicated; in this country and in others it is usually undertaken by men whose chief occupations are different and of various descriptions. These agents are generally paid by a certain rate of commission on the amount of premiums which they gather in. Members of the legal profession are usually dealt with as the agents of any company with whom they are pleased to transact business, without being restricted, as many ordinary agents are, to the service of one office; but at the present time legislation is threatened which may put an end to the payment by one party to a transaction of anything that might be imagined to be a bribe to an agent of the other. Circumstances have led to a large development of a system by which the ordinary agents of a company are visited, assisted, and stimulated by Officers of the company, engaged especially for this duty; and it has been found very desirable, if not necessary, even within the comparatively narrow limits of the United Kingdom, to have this branch of the business cared for at numerous local centres, in direct communication, of course, with the headquarters. Hence the familiar arrangement of agencies, local inspectors, and branch offices.

Beginning with the work of an agent, his primary duty is to induce as many persons as he can to insure with his office. He will endeavour, of course, to show the desirableness of insuring with some office, and what advantages he can offer on behalf of his own. In the active competition for business which exists, there is, of course, a great temptation not only to plead for one's office but to be critical about others. This is generally a mistake. There may be offices of a character which it will be reasonable and even a duty to warn one's friends against, but in general it will serve the agent's purpose best to be not merely just but even generous towards other offices. To attempt to discredit them will be apt to suggest that his own may be open to objections, if the

whole truth were known, and may produce hesitation and delay in acceding to his suggestions. It is, on the whole, better for each competing office that there should be a general feeling of unimpaired confidence in such institutions, than that one should be unduly magnified by its own paid officials at the expense of the others.

An agent having secured a proposal, his next business is to transmit it to the office of the company with which he is in immediate contact. He has, no doubt, been furnished with a printed form for this, and with a volume of instructions which he will do well to master. It will be his duty—and in the end it will be for his own interest—to see that the business he introduces shall be of a kind likely to be profitable to the company, and that at all events the officers of the company shall have as ample means of judging of this as he can supply. A correct description of the property, a matter of importance to both parties to the transaction, and of any elements of risk attaching to it, the character of the proposer, the existence of any other insurance by the Company on property in the neighbourhood, and many other particulars will accompany the proposal, and in general it will be expected that the property shall have been seen by him or some one in whom he has confidence. He will generally be empowered, when he sees it to be proper, to grant immediate protection; but, of course, he will lose no time in transmitting the whole matter to the office, with such information or suggestions as he can give.

In many cases it will be necessary for the office to have a more thorough examination of the property than an ordinary agent can be expected to make; and so we arrive at a class of officers known as Surveyors, whose services are of great value. A thoroughly qualified surveyor will not only have powers of close observation, but will possess no small amount of scientific knowledge fitted to suggest the mechanical and chemical conditions likely to create or to promote combustion. He will, of course, be master of the rules adopted by his office and by the Insurance offices generally in the fixing of rates, and he will, no doubt, have his eyes open to anything that would suggest what is known as moral hazard.

And now the proposal with the reports of the agent and surveyor reach the company's office, and are at once looked at critically. If the property is of a kind which forms the subject of a tariff the rules and rates of the tariff will be applied.

Attention will have to be given to the form in which the property is to be described in the policy, requiring often great care, so as to leave no doubt as to the precise property insured, its limits and its present condition, to prevent the risk being increased without permission, and any other particulars which form the basis of the rating. The policy when made out and duly signed will, no doubt, be fully recorded in a register—*i.e.*, the MS. portions of it—and in several separate lists: in one, where the premium will be charged against the agent, who will receive and account for it; in another, where it will appear under the heading of the term at which it will fall to be renewed; and in another, where it will appear under the heading of the locality in which the property lies, so that it shall be known what risks the company are running in each locality. This latter record will have been searched lest the addition of this property shall have involved the company in too large a risk in one neighbourhood. At this stage, also, when the business has reached the company's office the important work of re-insuring may have to be attended to.

The ordinary history of such a policy will include its renewal from year to year, involving many considerations, as the preparation of receipts and notices, their transmission to branches and agencies, the days of grace to be allowed, the settlement of agents' accounts, and other matters. When a policy has, after full consideration, been issued and paid for, it might be thought that, excepting the details just referred to, there is no need to give it further attention. But this is far from being the case. The granting of such a policy is the undertaking of a serious obligation which must be constantly kept in view. Every day may throw fresh light on the nature of the risk undertaken. It may be altered in itself in spite of warranties, but even if no change takes place in the nature or situation of the property insured, there may be frequent occasions for reconsidering the degree of risk involved. Other property in the immediate neighbourhood may come to be insured, and the danger of excessive loss by one fire will have to be guarded against. This raises some difficult questions. Suppose a street in some city like Glasgow, where every building contains goods requiring to be insured, often for large amounts. Is it safer to retain a small sum on each of them or to insure only, let us say, every second tenement? What of connections between them, doors or common roofs, or common

chimney shafts, or common extensions behind? There are some well-known city districts which present very difficult problems, such as the dry goods warehouses in the centre of New York.

But the most important sequel to the issue of a policy will be the occurrence of a fire by which the property is destroyed or injured. A letter, a telegram, or the public newspaper, none of them ever opened without some anxiety, intimates the occurrence. The origin of the fire is, perhaps, surrounded by more than the common mystery, and the first duty may be to institute enquiries demanding more than common acuteness and tact. Then to ascertain the quantity, the quality, and the value of the property injured, and the degree of injury is often a work of no little anxiety. Its destruction has swept away the readiest proof which could have been given; or where partial damage only has been sustained, it is often scarcely capable of exact measurement. Even where the cost of replacing a building may be capable of exact measurement curious questions may arise, as in two cases I can recall. One was the loss occasioned by the burning of a house which, strangely enough, happened to take fire just after it had been ascertained that it was sinking into ruin, owing to the development of a coal pit immediately below it, and had just been cleared of its furniture. Another was the case of a house in the old town of Edinburgh which had been sold to the authorities in order to be removed. The owner would receive the price that had been agreed on irrespective of the fire, and the Corporation lost practically nothing. In both cases a proposal to restore the houses where they had been—an option which the Company was entitled to exercise—afforded a very reasonable test of the loss sustained by their owners in consequence of their being burned, as they naturally preferred a much smaller payment in cash. In the ordinary case the insured is, of course, bound to state and prove his claim, and in dealing with it the office may have many things to attend to, matters of accountantship and book-keeping, perhaps even questions as to the character and circumstances of the claimant, customs of trade, and the best methods of dealing with the salvage. Then there may be other Offices falling to be dealt with. One may have insured only a portion of the property, while another has embraced under one head this and other properties. Some offices may have granted "average" policies, some specific policies; some may have insured the true owner, some the person in possession, some the mortgagee.

Questions have occasionally arisen out of such circumstances which have defied any but a Gordian solution, but in all cases they make some demand on the brain and on the common sense and temper of those who have to deal with them.

Fortunately for all parties, there are strong motives on every side tending towards a reasonable adjustment. In most cases the office is guided by the advice of an independent professional valuer, who, while attending to the interests of his employers, has a natural desire, even apart from his instructions, to conciliate the claimant, and to avoid landing the company he represents in troublesome controversies. Claims which cannot be adjusted in this way are usually submitted to arbitration, and it is a condition of most policies that both sides must refer the quantum of loss to an arbiter or arbiters, though not any question as to legal responsibility. Few claims find their way into the courts of law; and the Offices naturally shrink from litigation unless some important principle is involved, such as a breach of warranty, or where the claim is thought to be fraudulently overstated, or where the still more serious objection is taken that the fire has been the wilful act of the insured.

There are few grander or more startling sights than a great conflagration. It seldom fails to involve the intensifying interest of danger to human life. It is said that in London the number of lives lost at fires during the last ten years has been 776. But apart from this, it is a scene ever to be remembered. Witness the sudden alarm, often at dead of night, the hurried and hairbreadth escapes, the rapid progress of the flames lapping from window to window and from floor to ceiling, the imminent danger of the adjoining buildings, the rush of the fire-engines and the heroic daring of the men, the glare reddening the sky and reflected from the livid faces of the eager yet awestruck crowd, the varying incidents of the unequal struggle between fire and water, the temporary languor of the flames and their outbursts of fresh fury, the crash of ruined walls and rafters, and the final catastrophe when the roof falls in, leaving the bare and ghastly gables to enclose a furnace of seething fire. The least interested spectator of such a scene cannot behold unmoved the rapid destruction of property, and the manifest helplessness of man in the presence of one of Nature's forces, so fierce, so stupendous, and so irresistible. And when the flames have expired from lack of aliment it is a piteous thing to stand amidst the charred and

dreary ruins of what so lately was perhaps a palace adorned with treasures of art which no money can replace, or a factory crowded with ingenious mechanism, or a warehouse stored with costly and beautiful fabrics, or some modest homestead, around whose bleached walls there cling memories of domestic joys and of sorrows even more sacred:—

> "In the blank voids that cheerful casements were,
> Comes to and fro the melancholy air,
> And sits despair:
> And through the ruin blackening in its shroud
> Peers, as it flits, the melancholy cloud."

Scarcely more sad it is to wander, as I have happened to do oftener than once, from house to house and from street to street of some hapless city which accident or design has made the prey of fire.

The loss and waste and misery occasioned by some great conflagration may be so distributed as to be more easily endured. It is the beneficent object of Fire Insurance to effect this distribution, and those who are engaged in the work may rejoice that their calling, like that of Life Assurance, confers so great benefits on their fellow-men. Few occupations afford a wider range of interests. Some idea has already been given of the variety of subjects with which members of this profession may have to deal; and it is to be remembered that their knowledge about insurable property, the risks it is exposed to, the terms on which it may be insured, and the considerations which will affect the settlement of claims, must extend to the endless variety of conditions which these questions may present in different countries, since many British offices transact business of this sort in almost every portion of the world.

In this department of business, as in every other, there is room for a man to evince, not merely knowledge and capacity, but a scrupulous sense of honour and an unflinching integrity. It is comparatively easy in almost every walk of life to purchase a measure of success, more or less temporary or prolonged, by questionable means, for in modern business the speed and bustle, the eagerness of competition, and an impatience of moderation threaten to carry us off all firm footing. But some nobility of soul, we may hope, is not inconsistent with a zealous interest in our calling. Let us try, then, amidst all its activities, to keep our

minds pure, our aims high, and our hearts warm, to recall to ourselves and to those around us that the faithful and successful performance of our professional duties, which forms, and rightly forms, so large a portion of our lives, is not the whole end of our existence; and to strive, through God's grace, whether within the limits of our daily business or beyond them, so to conform to His mind and will in all things, and so to trust to His promised help and guidance, as to glorify him, that we may enjoy His favour now and for ever.

JOHN M. M'CANDLISH, F.R.S.E, F.F.A.

Insurance and Actuarial Society of Glasgow,
8th January, 1900.

CHARACTERISTICS OF THE TABLES OF MORTALITY.

THE subject to be placed under review this evening will, I am sure, be conceded by every member of the Insurance fraternity as one of the utmost importance in relation to Life Assurance Societies and analogous institutions.

I understand that this contribution is designed by the Federation to more particularly benefit the junior section of our profession, who are in pursuit of the knowledge with which to be efficiently equipped for the ordeal of the examinations organised by the Federation; and, recognising the peculiar functions to be performed by this production, I have endeavoured to conform to what I apprehend to be the exact spirit of the executive of the Federation by presenting the subject, as far as possible, untrammelled by any actuarial notation.

The question of mortality is directed to the very foundation and base from which the superstructure of Life Assurance is evolved. In constructing a table of premiums for the transaction of Life Assurance business, it is essential to take cognisance of the rate of mortality which may be anticipated in the future; and then, by a combination of these rates of mortality, or functions, with a suitable rate of interest, we produce, by clearly defined actuarial operations, the mathematical or net premiums, which, when properly adjusted or loaded for expenses, constitute the article paraded before the public in the prospectus issued, and by which we cater for proposals, aided, of course, by the liberal regulations of the Society.

The Life Assurance Companies Act of 1870 invests the subject with a special importance by virtue of the fact that question No. 3 of the fifth schedule requires a statement of the table or tables of mortality employed in conducting the actuarial investigations in pursuance of the requirements of that Act. It may be of interest for me to observe, although somewhat alien to the

subject, that this Act imposes upon each of the Life Assurance Companies operating within the United Kingdom the obligation to periodically institute an investigation into the affairs of the Company; and that, in respect of all Life Assurance Companies established prior to the passing of the Act, each such investigation must be made at intervals not exceeding ten years; and that, in respect of all Companies established subsequent to the passing of the Act, the investigation is to be instituted at intervals not exceeding five years. The results, as you are doubtless aware, require to be prepared in harmony with the fifth and sixth schedules, and transmitted within nine months from the date of such investigation to the Board of Trade for inspection and subsequent submission to Parliament. In the case of Companies instituting annual valuations, the returns, in the form just described, require to be made at intervals not exceeding three years.

In measuring and gauging the mortality and liabilities of Life Assurance Societies and of kindred institutions, an essential element to observe is the character or peculiarity of the table of mortality employed. In conducting a mortality investigation we should endeavour to ascertain whether the table of mortality used for the purpose is the most correct and accurate index of the mortality which may reasonably be anticipated from the composition of the Society, having proper regard to the locality or localities from which the Society derives its constituents, and to the severity and nature of any test applied to such constituents prior to admission to the Society. Again, in conducting an actuarial investigation to ascertain the position of such a Society, we should also endeavour to ascertain whether the table of mortality used—combined with a suitable rate of interest—is the best adapted to the circumstances of the Society investigated, and will result in producing adequate reserves, or a safe and correct measure of the liabilities. It is most important to know, in pursuing such investigations, how the mortality table will influence or affect the reserves.

I think you will concur with me that the deduction forced upon us is, that there should be a correlation between the constitution of a body of persons investigated as previously explained, and the material from which the table of mortality employed has been evolved.

The mortality tables which have been constructed from time to

time are so numerous that it would be an impossible performance for me to review their characteristics within the compass of a paper restricted to the recognised limits. Some of these tables are constructed from observations confined to specially selected lives, such as lives insured in our Insurance Companies, and from which it is only natural to anticipate a rate of mortality more favourable than that incident to the general population. As a subsidiary feature in connection with these selected lives, I may observe that it is desirable to know whether the mortality table has been constructed from observations based upon lives only; or whether the basis has been the policies actually issued; or whether the amounts assured in respect of each policy have constituted the data.

Tables have also been evolved to indicate the mortality incident to lives differentiated by occupation, such as the clergy, publicans, miners, the military engaged in war, and so on; and there is now at the disposal of the statistician tabulated material to accurately indicate the true increased hazard to which a life is exposed by residence in various unhealthy districts. Tables have also been formulated from the observations of an entire nation, as well as from the statistics of an isolated district or locality.

A very convenient solution to the problem of electing the tables of mortality to review, as regards their characteristics, is obtained by considering what tables have been prominently used by the Life Assurance institutions incepted in this country, insomuch that the peculiarities of such tables should possess great magnetic fascination for us.

A retrospect of the operations of our domestic Life Assurance Societies reveals that the Northampton, Carlisle, 17 Offices, English Life No. 3, and the Institute of Actuaries HM Tables of Mortality have played a very prominent part in the affairs of such Societies, and these are the tables I propose to review.

The Northampton Table, or the "Good Old Northampton Table," as it is popularly termed, was the first table to achieve distinction, as it was almost invariably incorporated in the operations of our Life Assurance institutions for the computation of premiums, and for estimating the mortality and liabilities.

The first Northampton Table was formed by Dr. Price from the Bills of Mortality of All Saints Parish, Northampton, for the 36 years 1735-1770, in which the deaths were recorded for ages 0–2,

2–5, 5–10, and, after that, in groups of 10. The number of deaths during these years was 3690, and the number of christenings 3242. He assumed that the population of Northampton was perfectly stationary, and that the excess of deaths over births, numbering 448, was due to the deaths of persons who immigrated into Northampton at age 20.

The second Northampton Table, published in 1783, popularly known as the "Good Old Northampton Table," and which, for a considerable number of years during the present century, has played so prominent a part in our Life Assurance institutions, was constructed by Dr. Price from the Bills of Mortality in respect of the same parish, extending over the 46 years 1735–1780. The number of deaths during this period was 4689, and the number of christenings 4220, the difference of 469 being 10 per cent. of the deaths. He, however, actually assumed that 13 per cent. of the deaths were those of persons coming into Northampton at the age of 20, but assigns no reason for pursuing this course. The number of deaths between ages 20–30 was, as in the previous table, greater than the number of deaths between ages 30–40; but, as this peculiarity was not revealed in any other register of mortality, he ascribed it to local and accidental causes, and equalised the deaths in these two groups.

His graduated table of mortality indicated that from ages 21–75 the numbers living approximated very closely to an arithmetical progression.

The Northampton Table is an example of a faulty and erroneous foundation from which to evolve an accurate and correct index of mortality. It was conceived on the hypothesis that the population was stationary, but the fallacy of this assumption has been exposed. It has been clearly established that the population of Northampton in the last century was not stationary, and that the excess of deaths over births was principally attributable to the fact that there was a great proportion of Baptists in the locality, who repudiated infant baptism. The deaths, consequently, of those persons which he assigned to the immigration into Northampton of persons just 20 years of age were attributable chiefly to those births of which no record was made. His assumption, therefore, did not harmonise with the actual and true conditions, and the table was, consequently, defective and untrustworthy. I may observe that the mortality in All Saints Parish was higher than the mortality of other parts of the sub-district,

and higher than the mortality in England. In a very important and valuable contribution to the Journal of the Institute of Actuaries, the late Mr. William Sutton makes, *inter alia*, the following observations:—"The second Northampton Table differs "but slightly from the first, and it is difficult at first sight to "account for the prominent part the Northampton Table has since "taken in the insurance and annuity business of the country. "Much of this prominence is undoubtedly owing to the fact that "the table was adopted as the basis of the rates of the Equitable "Society; and it seems by no means improbable that the success "of that Society was one of the reasons which led the Govern- "ment in the life and annuity scheme passed in 1808 to make the "Northampton Table the basis of the annuity rates, entirely "ignoring the fact that what is profitable to the buyer of "annuities will be unprofitable to the seller. No doubt, Dr. "Price's acknowledged ability and reputation carried great "weight with Mr. Pitt's Government; but Dr. Price had been "dead some seventeen years, and it is by no means unlikely that, "could he have been consulted, he would have advised against the "adoption of the Northampton Tables. It is still more remark- "able when we remember, as Mr. Frederick Hendricks explained "in a paper read before the Statistical Society in 1856, on the "'Financial Statistics of Government Life Annuities,' that Mr. "Pitt had, so far back as 1789, already at his command other "tables, and had contemplated their employment, these tables "giving much higher annuity values than those of the Northamp- "ton—in fact, differing little from those of Mr. J. Finlaison's "Government Annuity Tables of 1829. However, whatever the "cause, we know that the Northampton Table was used, and with "what result, to our cost."

The Northampton Table represents a rather heavy rate of mortality in comparison with the corresponding functions of the more recent tables. The effect of this relatively abnormal rate of mortality, as indicated in the Northampton Table, is to depress the expectation of life and the annuity values, and to enhance the values representing the net premiums deduced from this table. A serious fallacy was commonly prevalent, and which involved very great danger to Life Assurance Societies—namely, that a table indicating a heavy death-rate would be the best and safest guide and guarantee for success, so far as the actuarial and scientific aspects of Life Assurance were concerned. Let us analyse this

view to see to what extent it is justified. By the aid of actuarial science it can be easily demonstrated that, in respect of a table of mortality to which a heavy death-rate is incident, the net premiums deduced therefrom will be higher than those deduced from a table with which a lighter rate of mortality is associated. As I have already announced, the Northampton Table represents a relatively heavy rate of mortality, and, consequently, the net premiums based on it are relatively heavy. So far as the calculation of the premium is concerned, no objection could very well be sustained, viewed in the light of securing as high a premium as possible for the contract. It was probably this feature of the Northampton Table which induced the directors of the Equitable Society to adopt this table in preference to the London observations. But, gentlemen, the premium aspect represents only a fraction of the case. There is another phase of the subject to which I must direct your attention, and which is of vital and enormous importance—namely, the influence of this Northampton Table upon the reserves. You will all recognise the importance of creating adequate reserves, and the seriousness and danger of any influence or instrument which would detract from this standard, by the production of an insufficient reservation of cash to provide for future engagements. Now, we ask, is the Northampton Table a safe or dangerous instrument to employ for this purpose? By recourse to actuarial formulæ it can be most conclusively established that, as regards without-profit policies, the reserves or liabilities resulting from the employment of this table in valuing the contracts are very considerably underestimated. The period during which the Northampton Table is so defective is from about age 20 to about age 50. Now, the largest proportion of assurances are effected at young, or comparatively early ages, and in respect of which the annuity values of the Northampton Table are depressed; but the heavy liabilities occur when the contract has subsisted for some years, and when the life is getting advanced, at which ages the annuity values are more accurate; and by an actuarial formula, expressing the value of the policy in terms of the annuity values, it is very clearly and obviously demonstrated that such policy values underestimate the liabilities of an Office adopting such table. In fact, the reserves evolved by the employment of the Northampton Table rank among the lowest; and hence the great danger incurred by Life Assurance Societies incorporating this table in their actuarial investigations.

The effect of this table would be to delude the directors of a Company, in the absence of accurate knowledge as to this great defect, by paying a tribute to the administration of the affairs, by the production of an inflated surplus, and the declaration, possibly, of an excessive reversionary bonus.

There is now, I believe, only one Company, operating in this country, which employs the Northampton Table, and that by compulsion of the requirements of its constitution; but, as a safeguard against this serious defect, a very large proportion of the surplus is invariably carried forward, regulated, no doubt, by the results of an independent valuation on a more severe and more modern and commendable basis.

TABLE indicating the Reserves required, according to the Northampton Table, in respect of a Policy for £100, after the Policy has subsisted for the number of years stated. Interest, 3 per cent.

Age at Entry.	Rate of Mortality.	Expectation of Life.	Value of a Policy at the end of		
			5 Years.	10 Years.	15 Years.
20, . . .	·01403	33·43	4·197	8·742	13·752
30, . . .	·01710	28·27	5·490	11·578	18·021
40, . . .	·02091	23·08	7·292	15·218	23·332
50, . . .	·02835	17·99	9·571	19·787	30·748
60, . . .	·04024	13·21	13·665	28·237	42·475

We will now consider some peculiarities of the Carlisle Table of Mortality. With the advent of this table it is important to observe that the Northampton Table was destined very soon to be relegated to a secondary position, and to be regarded more in the light of an actuarial curiosity than as an instrument to be employed in Life Assurance affairs.

The data from which the Carlisle Table was constructed were the enumerations of the population of St. Mary and St. Cuthbert, Carlisle, in 1780 and 1787; and the deaths which occurred in the same two parishes during the nine years commencing with 1779, and terminating with 1787.

The statistics were given for ages 0–5, 5–10, 10–15, 15–20, 20–30, 30–40, and so on.

The numbers living at the enumeration in 1780 were 7677, and in 1787 the numbers were 8677.

The aggregate deaths for the nine years 1779–1787 were 1840.

In order to determine the entire population exposed to risk of death during the eight years, the two censuses were combined, and the result multiplied by four, and a deduction of one-ninth of the entire deaths was made in order to obtain the number of deaths attributable to the population exposed during the eight years.

You will observe that Milne, in constructing the Carlisle Table, operated with two forces—namely, the enumeration of the population and the enumeration of the deaths; and to him must be accorded the honour of having first published a table of mortality by which a comparison is actually instituted between the numbers dying and the numbers living. Previous efforts at the evolution of mortality tables have been rigidly confined, so far as published efforts are concerned, to an operation upon the deaths only, and it is extremely probable that the tables purporting to represent the rate of mortality owe their designation of "mortality tables" to this fact, that the deaths alone were the basis. Except under almost impossible conditions, the method of deducing a so-called mortality table from the enumeration of deaths alone would evolve a most erroneous index as to the probable rate of mortality; and the only true and recognised plan by which we can arrive at a correct estimate or measure of the probability of dying is by a comparison of the deaths with the numbers living in respect of each age. Now, the Carlisle Table is the first publication in which the correct procedure has been observed to ascertain the functions representing the rate of mortality.

It has played a very prominent part in the affairs of our Life Assurance Companies, and it has also been the standard table by which the values of life interests and reversions have been estimated.

The composition of the data from which this table was derived rather detracts from its utility in the affairs of our Life Assurance institutions, insomuch that the female element amounted to 4813, as against 3864 males—a ratio bearing no resemblance to that obtaining in the records of our Life Assurance Companies.

The real value of a policy is underestimated by the Carlisle Table, but from a different reason to that which explained the depressed values produced by the employment of the Northampton Table. As I have just observed, in the population of Carlisle on which

the observations were made the females predominated, and aggregated about 55 per cent. The Carlisle Table accordingly displays the characteristics of female life to a very considerable degree, indicating the greater vitality of the older ages, and the greater mortality at the central period of life. In comparison with the generally accepted and recognised standard by which we now measure the expectation of life—namely, the Institute of Actuaries HM Table—the average duration of life according to the Carlisle Table is less than that exhibited in the HM Table under the age of 36, where it steadily increases until, at the age of 93, the excess is more than two years. And by pursuing a course similar to that depicted in the case of the Northampton Table, by which I suggested the value of a policy in terms of the annuity, we immediately establish that the policy values evolved by the employment of the Carlisle Table are depressed, and that the liability is underestimated, in the instances where the defects just referred to are displayed.

In various respects the Carlisle Table gives somewhat anomalous and irregular results which further tarnish its utility, as surveyed from a strictly scientific point of view.

Operating with age 95, we discover the value of the annuity, by such table, at 3 per cent. interest, to be 2·757, and that for age 91 the corresponding value is 2·481.

Further, the table is ill adapted for the computation of short-period or temporary assurances, as is evinced by the fact that the net premium—taking interest at 3 per cent.—to provide for the risk of death during one year, on a life aged 45, in respect of a contract of £1000, is £14 8s., while the corresponding value in respect of a life aged 50 is only £13.

Irregularities of the character which I have just adduced would also lead to anomalous results in respect of survivorship assurances.

[TABLE.

TABLE indicating the Reserves required, according to the Carlisle Table, in respect of a Policy for £100, when the Policy has subsisted for the number of years stated. Interest, 3 per cent.

AGE AT ENTRY.	Rate of Mortality.	Expectation of Life.	Value of a Policy at the end of		
			5 Years.	10 Years.	15 Years.
20, . . .	·00706	41·46	4·534	9·422	14·371
30, . . .	·01010	34·34	5·464	11·746	17·970
40, . . .	·01301	27·61	7·053	15·655	26·092
50, . . .	·01342	21·11	12·374	24·904	35·190
60, . . .	·03349	14·34	13·698	29·310	43·332

We will now briefly glance at the English Life Table No. 3. This table was constructed by Dr. Wm. Farr, the Registrar-General, from the material provided by the census returns, estimated to the middle of the years 1841 and 1851, and the deaths which occurred during the seventeen years 1838 to 1854. The population in respect of the year 1841 was 15,929,492, and for the year 1851 the number was 17,982,849.

The deaths in respect of the seventeen years referred to amounted to 6,470,720.

By a highly scientific process, which it is not the function of this paper to elucidate, the living were computed for the year 1838 by operating on the data, in order to obtain a perfectly harmonious relation between the period embraced by the living and the period embraced by the deaths.

The final table evolved from this material was divided into three sections—(1) Persons—comprising both sexes; (2) Males; and (3) Females.

The table comprising persons without differentiating the sexes had for its radix, or initial quantity opposite age 0, the number 1,000,000.

The radix, or the leading quantity in respect of the males table was 511,745, and for the females 488,255.

As this table has been compiled from the statistics of an entire nation, it must, I think—provided the information has been accurately reported, and the manipulation of the data has been

conducted on right lines—be obvious to you that it is eminently adapted to be regarded as the best criterion by which the mortality incident to the general community may be gauged; and that, by virtue of this characteristic, it may be considered the best standard for estimating the mortality and liabilities of those Companies transacting industrial business (as distinguished from ordinary Companies), owing to the magnitude of the operations of industrial Companies, coupled with the fact that there are no medical examinations. This language must not be misconstrued. I am speaking solely of the operations of the industrial branch of a Company transacting both ordinary and industrial business. In the ordinary branch of such Companies medical examinations are conducted with the same severity as obtains in Companies transacting purely ordinary business.

The natural sequence is that, on referring to the returns deposited with the Board of Trade, we discover that the English Life Table No. 3 is an invariable feature of the actuarial investigations of Companies transacting industrial business.

A characteristic of this table is that the rate of mortality during the youthful period of female life is in excess of that representing the male mortality.

A considerable number of years ago there was a great controversy on the subject of female mortality when contrasted with the male mortality; and the late Mr. Finlaison (a great authority on such matters) maintained that the fact is undoubtedly certain that the mortality of the female sex at every early period of life is less than that of the male sex at the same ages, excepting only in infancy; and seconded his assertions by the production of evidence gleaned from observations made on the nominees of certain tontines, and also on the Government annuitants from 1808 to 1825.

Again, Mr. Alexander Finlaison, in referring to the English Life Table, made the following remarks:—"At the youthful and " earlier adult ages the mortality of the female is represented to " be greater than that of the male. This conclusion is contrary " to most previous experience. It is a result which is also con- " trary to nature. The sexes are not created in equal numbers. " For every 20 females there are produced 21 males. But no fact " is more thoroughly established than that whenever the population " is counted the females are present in considerably greater " number. Such a result could not take place unless the stronger

"sex were subjected to a higher rate of mortality, and die off "much faster than the females."

Messrs. Bailey and Day, in a paper on the rate of mortality prevailing amongst the females of the peerage, dissent from these observations. They contend that Dr. Farr's conclusion is not contrary to most previous experience, and observe that "not only "in the English Life Table, but also in the observations on the "inhabitants of healthy districts, on assured lives, and on the "Society of Friends, the mortality of the female in the youthful "and earlier adult ages is found to be greater than that of the "male. And in every published table of mortality to which we "have been able to refer, excepting only Mr. Finlaison's and the "Swedish tables, the mortality of the female is at particular ages "in excess of that of the male. The peculiarity of Mr. Finlaison's "results may perhaps be accounted for by the probability that a "large proportion of the females in his observations are unmarried, "and by the scantiness of his materials in middle life, compared "with their abundance at the older ages. The English Life Table "is not contrary to nature, for, concurrently with the greater "mortality of the female at particular ages, we almost invariably "observe a greater general mortality of the male. The two "circumstances — the excess of male births, and the greater "general mortality of that sex—together cause that nearly uniform "proportion of the sexes which successive enumerations disclose."

Messrs. Bailey and Day further observe that the result of their investigations is to confirm the views of Dr. Farr, and not those of Mr. Finlaison; and that, on the whole, if human life be divided into three great periods—infancy, maturity, and old age—the weight of evidence is in favour of the general conclusion that at the two extremes the mortality of the female sex is less, and at the intervening period greater than that of the male; the probable after-lifetime being, at all ages, greater for the female.

In the appended table I adduce specimens of the reserves evolved by the employment of the English Life Table No. 3, in combination with interest at 3 per cent., in respect of contracts for £100 :—

Age at Entry.	Rate of Mortality.	Expectation of Life.	Value of a Policy at the end of		
			5 Years.	10 Years.	15 Years.
20, . . .	·00828	39·48	4·397	9·278	14·735
30, . . .	·01007	32·76	6·015	12·691	20·006
40, . . .	·01297	26·06	8·379	17·455	26·996
50, . . .	·01884	19·54	11·559	23·617	35·763
60, . . .	·03252	13·53	15·901	30·929	44·230

The next item for consideration in the programme is the Seventeen Offices' Experience. As the title indicates, this experience was derived from the material contributed by seventeen of our Life Assurance institutions. Some of the Companies had, prior to the initiating of this investigation, published the results of their own mortality experience for the benefit of the profession, the Companies so announcing their own experience to the world being, *inter alia*, the "Equitable," the "Eagle," the "Economic," and the "Law Life." But the maiden effort to produce a collective experience of the Offices was not organised until 1838, and which matured in the publication of the Seventeen Offices' Experience in 1843.

I may very appropriately interpolate here an analysis of the statistics comprised in the compilation, and this information is supplied in the appended table.

[Abstract.

Abstract of Data of Experience of Seventeen Offices, embracing 83,905 Policies.

	Number of Policies.	Total Numbers exposed to a Year's Risk at each Age.	Total Deaths.	Average Duration of Policies.	Percentage of Mortality on Col. 2.	Discontinued.	Existing.
Male Lives (Town), (B1), . .	16,097	89,601	1,190	5·6	1·3	4,457	10,450
Female Lives (Town), (B4), .	1,448	6,848	134	4·7	1·8	447	867
D 3, deduced from . . .	17,545	96,449	1,324	5·5	1·4	4,904	11,317
London Equitable, . . .	21,396	262,210	5,144	12·3	2·0	9,324	6,930
London Amicable, . . .	4,618	55,087	1,792	11·9	3·2	535	2,291
Other Town Experience necessarily inferred to produce next line, ...	5,141	59,914	914	11·7	1·5	..	..
Combined Town Experience—Table E, ...	48,702	473,660	9,174	9·7	1·9	..	..
Country, D4 (B2 and B5), . .	13,335	72,985	1,158	5·3	1·6	3,284	9,393
Table G, deduced from . .	62,537	546,645	10,332	8·7	1·9	..	..
Irish, D5 (B3 and B6), . .	9,236	51,621	1,446	5·6	2·8	3,038	4,752
Other Experience necessarily inferred to produce next line,	12,132	113,897	2,003	8·6	1·8	..	..
Total Experience, ...	83,905	712,163	13,781	8·5	1·9	..	..
Total Experience inferred, . .	17,273	173,811	2,917	0·1	1·7	..	..
						25,247	44,877

In connection with the foregoing table, I may explain that it is produced from a paper contributed by the late Mr. William Spens, in respect of which he makes the following remarks:—"I "have not observed any abstract exhibiting distinctly the general "divisions of the 83,905 policies embraced by the Experience of "Seventeen Offices; and, indeed, such abstract can only be made "out by inferring some details from others."

I may observe that the material operated upon in this investigation was the policies actually issued, or the contracts entered

into, and not the lives which had actually been recorded in the policy-registers of the Companies. This may appear to be a distinction without a difference; but there is a difference, and of such a nature that, in operating with a large number of contracts, it might have the effect of relatively distorting and disturbing the rate of mortality. As I have just observed, policies were operated upon as the basis, and not lives. The effect of this procedure was to count each policy as a life, notwithstanding the number of contracts or policies which may have depended on any life. Thus, suppose a party had four policies subsisting on his life, and that they were under observation in the compilation of the collective experience, they would be reckoned as if effected on four lives instead of being actually dependent on one life. It was considered then that the duplication of policies did not prevail to any very considerable extent, and that the results would not be materially affected by pursuing the course indicated. Duplicate policies were, therefore, not eliminated. It is, however, now very clearly established that mortality tables based upon policies evolve rates of mortality *too low* for the earlier periods of life, and too high for the lives of the more advanced ages. In support of this assertion I adduce the appended statement, derived from the experience of the Economic Life Office and the Connecticut Mutual Life Office.

TABLE indicating Rates of Mortality.

AGES.	ECONOMIC.			CONNECTICUT MUTUAL.		
	Lives.	Policies.	Amounts.	Lives.	Policies.	Amounts.
7-40, . .	·00761	·00748	·00677	·00737	·00736	·00745
41-65, . .	·01809	·01818	·01727	·01309	·01324	·01359
66-90, . .	·06263	·06580	·06440	·05112	·05270	·05381
7-90, . .	·01482	·01502	·01447	·01122	·01137	·01155

You will observe that, in respect of the first group, the rate of mortality deduced from the observations of policies is less than the corresponding rate deduced from lives; that, in the second group, the "policy functions" are higher than the "life functions"; and that in the last group the rates deduced from

policies are considerably in excess of those derived from lives. This is not difficult to explain. In the earlier periods of life, policies already exposed to risk are continually being augmented by the acquisition of further proposals in respect of lives already on the Company's records, necessitating the issue of policies harmonising with such proposals; but, as the lives get advanced in years, this duplication process becomes almost evanescent. The effect is, consequently, to produce a rate of mortality too low at the younger ages, and too high at the older ages.

One very important revelation of this investigation was the heavy rate of mortality reflected by the Irish lives comprised in the data, when contrasted with the rate of mortality in respect of the English lives; and the moral conveyed by this heavy death-rate was the necessity for the exercise of more caution in the acceptance of Irish lives, and the necessity for a surcharge or extra premium in respect of all such risks. In consequence of the abnormal rate of mortality found to prevail among the Irish lives, this data was rejected from the material in constructing the recognised table.

The final table, and which we recognise as the Seventeen Offices Table, was based upon 62,537 policies, the results derived from this material being subjected to a process of graduation by the late Mr. W. S. B. Woolhouse, in order to produce a more orderly series of functions for use in the scientific department of Life Assurance.

The statisties in respect of the initial ages and of the very old ages are too meagre to admit of reliable results being deduced.

Contrasting the graduated functions of the Seventeen Offices' Table with the probabilities of dying as represented in the Carlisle Table, we observe that up to age 50 the Seventeen Offices' Table produces the smaller functions, whereas, at the older ages, the probability of dying in a year is greater according to the Seventeen Offices' Table than by the Carlisle Table. And by a similar actuarial process, which I adduced in respect of the Northampton Table, we easily demonstrate that the values of policies deduced by the employment of the Seventeen Offices' Table are higher than the values obtained by the adoption of the Carlisle Table, and, of course, greater than the values derived from the Northampton Table.

This table, by virtue of the fact that it was compiled from statistics contributed by Assurance Companies, was obviously a

better criterion of mortality incident to carefully selected lives; and it was to a very great extent adopted by the Companies for estimating the liabilities or reserves, and for the computation of premiums, and ascertaining the expected deaths.

TABLE indicating the Reserves required, according to the 17 Offices' Table, in respect of a Policy for £100, after the Policy has subsisted for the number of years stated. Interest, 3 per cent.

AGE AT ENTRY.	Rate of Mortality.	Expectation of Life.	Value of a Policy at the end of		
			5 Years.	10 Years.	15 Years.
20, . . .	00729	41·49	4·189	8·962	14·370
30, . . .	·00842	34·43	5·941	12·677	20·304
40, . . .	·01036	27·28	8·735	18·225	28·152
50, . . .	·01594	20·18	12·319	24·507	36·694
60, . . .	·03034	13·77	16·142	31·310	45·048

And now, gentlemen, devolves upon us the review of the table which, in importance in relation to ordinary Life Assurance institutions, far eclipses any of its predecessors. I refer to the Institute of Actuaries' Healthy Males Table of Mortality, deduced from the "Twenty Offices' Experience."

In the year 1862 measures were initiated by a committee appointed by the Council of the Institute of Actuaries, aided by the co-operation of a joint committee representing the Managers' Association and the Faculty of Actuaries in Scotland, with the object of collecting the experience of the Offices in the United Kingdom, and which resulted in 20 Offices contributing their experience—10 English and 10 Scotch.

The particulars of each policy were inserted on cards so as to facilitate the arrangement and tabulation of the data in whatever manner was considered desirable or necessary.

The cards issued to the ten English Offices contained the following particulars:—

Policy No..............................	Life....................................
British, Irish, or Foreign............	....
Healthy or Diseased..................	....
Year of Entry...........................	Age at Entry...........................
Year of Exit.............................	Age at Exit..............................
Mode of Exit............................	....
Cause of Death.........................	Remarks................................

The card in operation in respect of the ten Scottish Offices differed but slightly from that given above.

As lives, and not policies, were to constitute the basis from which the table was to be evolved, it became necessary to eliminate all duplicate policies, so that, provided the contracts effected in respect of each life were continuous, the life would not be counted more than once in the observations, however numerous the policies may have been in respect of such life. When the policies were not continuous, observation was made of each policy, just as if each policy affected a fresh life, this process being adhered to until the continuous feature revealed itself. Suppose, for example, that a policy-holder, in one of the Companies contributing their experience, took out the policy in the year 1852, and that at the end of two years the policy was allowed to lapse. Let us assume, too, that at a later period, say in the year 1856, a new policy was effected on the same life, and that this latter contract subsisted at the close of the observations. Now, as an interval intervened between the discontinuance of the first policy and the inception of the second policy, in tabulating the statistics each policy would be treated as if the two policies were on two lives instead of one identical life. Suppose, however, that both the policies were subsisting at the period terminating the observations, then, in these circumstances, observation would be made of the particulars of the policy of longer duration, and the more recent policy would be discarded in the tabulation process.

I may here allude to one of the important characteristics differentiating the "Twenty Offices' Experience" from the previous mortality experience compiled under the jurisdiction of a committee of actuaries—the "Seventeen Offices' Experience." We have already seen that lives were adopted as the basis in the compilation of the experience of the Twenty Offices. In con-

structing the table in respect of the Seventeen Offices' Experience, you will remember that policies, as I explained to you, constituted the groundwork, and that in that experience duplicate policies were not rejected, as it was believed that they would not prevail to any considerable extent. However, during the interval of the two investigations it was recognised as a common feature in the practice of Life Assurance for more than one policy to be effected on the same life, occasioned sometimes through the exigencies of business, such as collateral security for loans, the mortgage of life interests, obedience to the moral dictates to increase the amount of existing assurances according to the quality or amount of surplus resulting from business prosperity, etc. Considering the frequency of such duplications, it was resolved to resort to lives as the basis from which to evolve a table of mortality in respect of the data contributed by the Twenty Offices.

The mode in which duplicate policies were collected together and eliminated was by arranging the cards in alphabetical order according to surname, and then bringing those together in which surname and Christian name were identical. The lives were afterwards divided into groups of healthy lives, diseased lives, and lives exposed to abnormal danger in consequence of occupation or climate.

The Healthy Lives consisted of those who were in a robust and sound condition of health at the period the assurances were effected, and who would accordingly have been reported upon to the Offices by the medical advisers as lives acceptable at the ordinary rates of premium for the class of assurance described in the proposal. These healthy lives were sub-divided into males and females.

The Diseased Lives embraced those whose family histories were so tarnished by disease, etc., as to depress the standard of the lives below the normal requirements of Life Assurance Companies; or it may have been that, although in some cases the family histories were in every respect satisfactory, the lives may have been victims to some ailments which had materially impaired, in the medical officer's estimation, their prospects of longevity, and thereby rendering such lives ineligible for acceptance at the normal rates of premium, yet not absolutely barring their acceptance by the Offices at such rates of extra premium as the circumstances of each case appeared to demand. In this division no discrimination is recorded between the two sexes.

The Lives exposed to Extra Risks comprise those whose pursuits or residence, either at the period of effecting the contracts or subsequently, rendered it essential, in virtue of the regulations of the Offices affected and in equity to the other policy-holders, to impose an extra premium commensurate with the increased hazard, so as to compensate for the Companies being exposed to probability of sustaining a claim earlier than would have been the case in the absence of such inimical conditions. In this section, also, no distinction is drawn between the two sexes.

The following statistics indicate the magnitude of the material operated upon :—

	1. No. of Lives.	2. Years of Life entered upon.	3. Deaths.		4. Discontinuances.		5. Existing.	
			No. of Deaths.	Per Cent. of No. of Lives.	No. of Discontinuances.	Per Cent. of No. of Lives.	No. existing at Close of Observations.	Per Cent. of No. of Lives.
Healthy Male Lives, .	130,243	1,283,034	20,521	15·8	35,024	26·9	74,698	57·3
Healthy Female Lives,	16,604	161,417	3,335	20·1	5,507	33·2	7,762	46·7
Both, . .	146,847	1,444,451	23,856	16·2	40,531	27·6	82,460	56·2
Diseased Lives—Male and Female, . .	11,146	101,695	2,456	22·0	3,365	30·2	5,325	47·8
Lives exposed to Extra Risk from Climate and Occupation—Male and Female, .	2,433	16,503	409	16·8	1,480	60·8	544	22·4
Summary, . .	160,426	1,562,649	26,721	16·7	45,376	28·3	88,329	55·0

For the purpose of recording the statistics, the cards were sorted and arranged into groups of existing lives, discontinued lives, and lives who had disappeared by death, and then arranged according to identical ages at entry and identical ages at exit.

As the Healthy Males (Hm) Table is the fundamental table in relation to Life Assurance Companies, I do not propose to adduce further statistics in reference to the other divisions, and I do not propose to enter into the subject respecting the manner in which the number of lives exposed to risk of death is obtained during each insurance year.

An exceedingly important feature incident to the Healthy

Males Table is the mode in which the number of lives exposed to risk of death at each age, and the number of deaths, are displayed, insomuch that we are enabled to watch and observe the influence of the duration of the contract upon the subsequent mortality. I have compiled the subjoined table for decennial groups of ages to exhibit the rate of mortality attributable to each 100 lives exposed to risk of death, for each of the recent years of assurance:—

Decennial Groups of Ages.	Rate of Mortality attributable to each 100 Lives exposed to Risk of Death during the Year of Assurance noted at the top of each column.				
	1st Year.	2nd Year.	3rd Year.	4th Year.	5th Year.
25 to 34, .	·383	·552	·743	·796	·988
35 to 44, .	·400	·691	·879	·991	1·081
45 to 54, .	·678	·932	1·267	1·492	1·409
55 to 64, .	1·112	2·096	2·257	2·464	2·807

The process embodied in the above table is capable of extension to the whole of the succeeding "assurance" years to the extreme limits of the table; and similar results could be evolved showing the rate of mortality per cent. in respect of the lives of one uniform age. It is not imperative to operate on decennial or quinquennial groups of ages; it is, however, very desirable to do so, because it has the effect of suppressing and extinguishing to some extent the erratic and uneven progressions which are generally manifested when isolated ages are selected.

Reverting to the rate of mortality deduced in respect of the first year of insurance, you will observe that the rate increases as the ages of the decennial groups progress in the direction of the advanced ages. Mr. Spens, the late manager of the Scottish Amicable Life Assurance Company, expressed his belief that there was no material difference of risk for a year in select or healthy lives from ages 20 to 25, and from 40 to 45. This view elicited a somewhat lengthy communication from Mr. Farren to the pages of the Journal of the Institute of Actuaries, describing the conception as fallacious, and adducing statistics to support his

contention. The implication conveyed in Mr. Spens' assertion is that the single premium for each £100 assured in respect of "Short Period" Assurances, restricted to one year, effected upon healthy or select lives, should be uniform or identical for all ages from age 20 to 45 inclusive. From your own experience you will be well aware that this theory has not obtained support in practice by our British Life Assurance institutions. As examples, I give in the subjoined table the rates of premium charged by three British Offices for the assurance of £100, payable only in the event of the life dying within one year from the inception of the policy :—

Age at Entry.	Royal Exchange.			Law Union and Crown.			Age at Entry.	Scottish Amicable.		
	£	*s.*	*d.*	£	*s.*	*d.*		£	*s.*	*d.*
20, . .	0	18	10	0	17	0	21, . .	0	18	6
45, . .	1	12	5	1	10	0	45, . .	1	8	7

The rates of premium for the intermediate ages will naturally be represented by values falling between those furnished in the above table. In the case of the Scottish Amicable, their prospectus does not give the premium at age 20 for this description of assurance.

I might adduce, if necessary, further specimens indicative of the practice of the Offices in relation to that particular class of business. I think, however, the three instances cited will suffice to demonstrate that the actuaries who are responsible for the safe administration of our Life Offices consider the difference of risk for a year, for such ages, sufficiently pronounced to necessitate a sliding scale of premium, advancing with the increased age.

I may now, in connection with this subject, refer to the estimate of the beneficial effects accruing to Life Assurance Companies from the care exercised in the selection of the lives, and the searching tests to which the lives are subjected by the medical officers of the Companies. Diversity of opinion prevails respecting the extent of its duration. Mr. J. A. Higham states that he has arrived at the conclusion that the effect of selection endures for a term equal to half the difference between the age at entry and 80. Thus, at age 20 the influence of selection will permeate the

experience for the ensuing thirty years. Taking age 30, the period becomes twenty-five years; and for age 40, the period is twenty years; and so on.

The gradual evanescence of the influence of selection is discussed in the mortality experience of the New York Mutual Life Office, and the deductions are:—

(1) That the advantage of selection diminishes at all ages with the duration of the policy.

(2) That it decreases very rapidly among those who insure at the younger periods of life.

(3) That it decreases very slowly at the middle period of life and among older insurants, and probably never entirely disappears.

In the HM Table (5), compiled from the mortality experience of the Twenty British Life Offices, already referred to, the assumption is involved that the beneficial effect of selection becomes extinct at the end of the first five years. In constructing this table, the experience during the initial quinquennial period of assurance, in the Healthy Males (HM) Table, is discarded and ignored, the residue of the experience being utilised to construct the HM (5) Table, to reflect the rate of mortality when not under the influence of selection, provided the benefit of selection to the Offices entirely vanished at the end of the first quinquennium. The assumption here made does not present the characteristics of a parallel with the revelations emanating from Mr. J. A. Higham, nor does it reconcile with the deductions recorded in the mortality experience of the New York Mutual.

It was maintained that if the beneficial effects accruing from selection had entirely vanished at the expiration of the initial quinquennial period of assurance, the rate of mortality in respect of lives of the same age which had been under exposure for more than five years should be identical with that deduced in respect of lives whose contracts had subsisted for more than ten years. Let us investigate the matter to see if the HM Table supports this contention. Operating with ages 40 to 44 we obtain the following statistics:—

Years of Insurance.	Exposed to Risk.	Deaths.	Percentage of Mortality.
5 and upwards, .	120,476·5	1,402	1·164
10 and upwards, .	59,662	747	1·252

You will observe that these figures do not support the theory to which I have just directed your attention.

Dr. Sprague—one of the most prolific contributors to the literature of the Institute of Actuaries—in a very important paper delivered to the Institute on the 20th December, 1869, has shown that when the duration of assurance is weighed, the rate of mortality among assured lives of the same age reaches a maximum, and then diminishes.

In this paper, Dr. Sprague observes—"It is universally "acknowledged that the rate of mortality among assured lives is "very light during the first few years that follow the grant of the "assurance, being extremely small in the first year, and gradually "increasing until, after the lapse of a greater or less number of "years, the mortality becomes, according to some authorities, "equal to that indicated by tables deduced from the population "at large; and, according to others, still heavier. This is, of "course, satisfactorily explained by the medical examination of "the life proposed for assurance, which has the effect of eliminat- "ing those persons who are suffering from such acute or chronic "diseases dangerous to life as can be detected by the medical "officers of the Assurance Companies."

Further—"If we consider how the medical selection of the "lives proposed for assurance operates, we shall see that there is "nothing impossible in the supposition that its effect may endure "and be traceable for any number of years up to 20, 30, or 40, or "even to the extreme limits of life. Among the population at "large, or among a very large number of persons chosen by lot, "there will be persons in every possible state of health. Some "will be on their death-beds, suffering from diseases which will "certainly kill them within a few hours, or it may be days or "weeks. Some will be in the last stage of a lingering illness, "such as consumption, of which they will certainly die within the "course of two or three years. Others, again, will be suffering "under the effect of acute diseases, such as fevers, or from the "effect of accidents, from which they may either entirely recover "within a few weeks or months, or recover only with impaired "constitutions and diminished prospects of life, or from which, on "the contrary, they may die. There will lastly be some who are "suffering from chronic diseases, such as heart-disease, which will "certainly on the average shorten their lives, but will not prevent "individuals among them from attaining extreme old age. In

"fact, it is easy to perceive that a body of such lives may "throughout be subject to a much heavier mortality than that "prevailing among the population at large, and yet that if "sufficiently numerous they may not all die before the extreme "age of the table of mortality is reached. The original medical "selection will more or less completely weed out from the persons "proposed for assurance those who belong to any of the above "classes. In this way it is undeniable that the Assurance "Companies will escape many premature deaths by the weeding "out of persons suffering from acute diseases; and it seems very "probable that the effect of the medical selection through weeding "out the persons labouring under chronic diseases will have the "effect of slightly reducing the rate of mortality even to the "extremity of life."

In addition to the disturbing influence of the medical selection, there is another force in vogue to which Dr. Sprague refers in the following language :—"The constant withdrawal from observation "of a greater or less number of the members by the lapse or "surrender of their policies. It is now generally believed that "after the lapse of a considerable number of years the mortality "among assured lives becomes greater than that among the "population at large; and this is attributed to the above, "mentioned withdrawals." Mr. Higham appears to have been the first to draw attention to this point. He says ("Insurance Magazine," vol. I., page 190)—"On comparing the probabilities of "living a year in the separate classes with those of Mr. Farr "given in the Reports of the Registrar-General, one is struck "with the fact that assured lives are for some time after selection "much better than the community at large, but that after a "while they become much worse. . . . This can arise from "no other cause than the selection which the assured exercise "against the Companies by dropping policies on healthy lives, and "retaining those on lives which have become bad or doubtful." But these views have not been accepted universally. "On the "contrary, opinions have been greatly divided as to the effect "produced by the withdrawals. It is clear that if those who "abandon their policies have, on the average, a superior average "to those who retain them, the rate of mortality among the lives "remaining assured will be greater than it would have been if "there had not been any withdrawals. But some authors have "given it as their opinion that policies are generally abandoned

"in consequence of inability to pay the premium, and that, conse-
"quently, the persons who abandon their policies, being mostly
"in embarrassed circumstances, will, on the average, possess not
"a greater but a less vitality than those who keep them up."

I may observe that Dr. Sprague throws the weight of his great name to support the contention that withdrawals exercise an injurious effect upon the subsequent mortality of the Companies.

The appended table is produced to indicate the progress of the mortality in respect of the years of assurance indicated; and from which you will observe, as I have remarked previously in this paper, that the percentage of actual deaths to the computed deaths gradually increases; and that in the years 11 to 15 a maximum is attained, after which there is a steady decline revealed.

TABLE indicating the progress of Mortality in respect of the years of Assurance indicated. Based on HM. statistics.

Year of Assurance.	Number at Risk.	Actual Deaths.	Expected Deaths.	Percentage of Actual Deaths to Expected.
0, ...	63,644·5	290	650·32	44·6
1, ...	116,565	891	1246·93	71·5
2, ...	103,312·5	1028	1156·45	88·9
3-5, . .	252,291·5	3177	3104·08	98·64
6-10, . .	288,416	4515	4295·06	105·12
11-15, . .	170,529	3589	3300·41	108·74
16-20, . .	96,560	2614	2483·78	105·24
21-25, . .	52,939·5	1877	1796·85	104·46
26-30, . .	26,232·5	1210	1168·66	103·54
31-63, . .	18,468	1250	1224·62	102·07

This table will, no doubt, be somewhat of a revelation to you, as you might naturally have expected that the results represented in the final column would have indicated a steady increment each year instead of gradually ascending to a maximum, and then presenting a decline. In explanation of this apparent anomaly, Dr. Sprague observes that it consists of the combined effect of the two causes to which I have referred—namely, (1) the gradual wearing out of the beneficial effect of the medical examination at entry, and (2) the effect produced by the withdrawal of healthy lives.

He remarks—"If we consider the way in which the withdrawal
"of healthy lives must affect the rate of mortality among the
"persons remaining under observation, we shall see that it may be

"expected to produce precisely the effect shown in the above "table, . . . and that the withdrawal of good lives increases "the proportion which the bad lives bear to the healthy. Now, "the greatest number of withdrawals take place within a few "years from the date of the policy, and after the lapse of, say, "15 years they become so few as to produce no appreciable effect "upon the mortality. In order, therefore, to trace the effect of "the withdrawals upon the rate of mortality, we may suppose "that in each year of assurance, up to the fifteenth, a diminishing "number of unsound lives is added to those surviving out of the "original number assured. These unsound lives will experience a "very much heavier mortality than the mixed lives which survive "from the original number assured; but, as their numbers are, "by supposition, continually recruited by fresh additions during "the early years of assurance, there will be a rapidly-increasing "number of deaths among them, which will have the effect of "causing the rate of mortality among the whole body to increase "faster than it would otherwise have done. But when we come "to the subsequent years of assurance, when the unsound lives "receive no new additions to their numbers, the heavy rate of "mortality prevailing among them will cause their number to "bear a continually diminishing ratio to the whole; and these "unsound lives will, consequently, exercise each year a less "influence on the rate of mortality. As far as they are concerned, "there will be a tendency for the rate of mortality to improve. "But, as the survivors are probably yearly getting, on the "average, worse, there is a tendency on that account for the "general mortality to get worse."

On the other hand, Mr. James Chatham, in his prize essay on Selection, has demonstrated that, in respect of the first ten years of assurance, discontinuances do not produce an injurious effect upon the mortality experienced by the residue of the lives—in fact, his deductions rather suggest the contrary theory. He established his case by operating with the Ten Scottish Offices contributing their data to the Twenty Offices' material, and instituted a comparison of the experience of the Ten Scottish Offices with the Institute. The appended table, based upon the data in respect of ages 23 to 42 at entry, indicates the unadjusted rate of mortality and discontinuances in respect of the Ten Scotch Offices and the Institute.

TABLE showing the Unadjusted Rates of Mortality and Discontinuances in respect of the years of Assurance indicated.

Year of Assurance.	Unadjusted Rate of Mortality.		Unadjusted Rate of Discontinuance.		
	Ten Scotch.	Institute.	Ten Scotch.	Institute.	Percentage of Ten Scotch to Institute.
0, . .	·0045	·0038	·007	·027	25·9
1, . .	·0061	·0061	·056	·068	82·4
2, . .	·0085	·0081	·039	·049	79·6
3, . .	·0090	·0092	·033	·041	80·5
4, . .	·0118	·0108	·027	·032	84·4
5, . .	·0104	·0101	·023	·028	82·1
6, . .	·0116	·0111	·018	·024	75·0
7, . .	·0107	·0107	·020	·034	58·8
8, . .	·0107	·0118	·017	·019	89·5
9, . .	·0113	·0118	·012	·015	80·0
10, . .	·0130	·0133	·012	·015	80·0

You will observe from this table that the rate of discontinuance in respect of the Ten Scotch Offices is less than that representing the Institute; and, in harmony with the doctrine propounded by such authorities as Dr. Sprague and Mr. Higham, the rate of mortality deduced from the Scotch experience should be more favourable than that indicated by the Institute.

Such, however, is not the revelation of this table, as, with one exception in respect of the first seven years, the better results are exhibited by the Institute. In discussing this feature a great authority in the actuarial world, Mr. George King, inclined to ascribe the result deduced by Mr. Chatham to the influence of a large number of short-period or temporary assurances present in the English Offices contributing their experience, which would naturally have the effect, as will be obvious to you, of expanding the rate of withdrawals, if, at the period the obligation in respect of such assurances terminates, they are incorporated with the retirants who discontinue in virtue of their exercising the secession option, which you are all aware may be exercised at pleasure by the policy-holders.

I do not now propose to further discuss this important feature, but to invite your attention to several other characteristics of the Institute experience. The result of the collective experience of the Twenty British Offices displayed a greater vitality among

healthy female lives than among healthy male lives from age 48 to the end of life. You are doubtless well aware that it is customary for some of our British Offices to charge extra premiums for females, usually 5s. per cent. per annum on the sum assured, until the attainment of a specified age, usually 50, when the extra premium is suspended. The regulations of some Offices also provide for the imposition of a further single extra premium in the event of pregnancy for the first time at the period of proposing her life for assurance. As to the equity and justice of surcharging the females until the child-bearing period is passed, some light is reflected by the remarks appearing in the prospectus of one of our leading Scotch Life Offices to the effect that the directors some years ago resolved to make an additional charge for females, owing to the heavy rate of mortality which had been found to prevail in their Society and in other similar Societies. The experience of the healthy female lives observed in the Twenty Offices substantially justifies the policy of surcharging females until the child-bearing period has disappeared.

Mr. J. R. Hart, who read a paper on an investigation into the mortality of the married females of the peerage before the Actuarial Society of Edinburgh, observed that the results of his investigation showed that an insurance on the life of a married female should be considered with regard to the time which she had been married; and that it would seem to be advisable in the case of an unmarried woman to stipulate for an extra premium on marriage. In the discussion on this paper Mr. D. Carment stated that the Australian Mutual Provident Society had abolished the usual extra premium in respect of female proponents, and that this reform had been instituted in harmony with the advice of three of the most eminent English actuaries who were consulted as to the safety of dispensing with the extra.

I believe that in Norway and Sweden females are accepted at less rates of premium than are charged for males, in consequence of the better vitality incident to female life.

We will now briefly consider the influence of the HM Table in relation to premiums. It is to be observed that the final table from which are evolved the annuity values and net premiums and other functions is what may be very appropriately described as an aggregate table of mortality; and by this term I mean that the influence of the "insurance duration" of the life, or the period during which the life has been exposed to risk of death

since the policy was effected, has not been weighed and given effect to in the construction of the table, all lives of the same attained age being combined, irrespective of the duration of the contracts. What is the tendency of this process? The effect is this—If those lives of the age of 50 who have just successfully survived the ordeal of the medical examination are amalgamated with those of the same attained age but who passed the medical examination thirty years ago—namely, at age 20—then the tendency will be for the rate of mortality to be depressed in respect of those lives entering at age 20, and, consequently, the annuity values will be greater and the net premiums diminished. The effect of this procedure does not terminate here. How does it influence the annuity values and net premiums in respect of lives aged 50 at entry? It must, I think, be obvious to you that the aggregation of lives aged 20 at entry who have been insured for thirty years, with lives aged 50 who have just passed the medical examination, must impair the functions representing the rate of the mortality of those lives only recently selected, insomuch that those persons who have been so long under exposure since the contracts were effected will in some instances have very much impoverished and impaired constitutions. Probably, in some cases, the lives, although still living, may be on the verge of death. In other instances, too, the lives will have survived with very much diminished prospects of longevity, and who, in the event of proposing to increase their assurances, would undoubtedly be immediately rejected on the advice of the medical referee. The rate of mortality being thus enhanced by this procedure, the resultant effect is that the annuity-values are diminished and the net premiums increased.

Generalising, the effect produced by the method of compilation employed in the Institute of Actuaries HM Table was the evolution of net premiums too low at the young ages, and too high at the old ages. This feature is very clearly established by the figures contained in the appended table, based on the HM Table and Dr. Sprague's Select Tables, in which the effect of the duration of assurance is taken into account.

NET PREMIUMS for £100, based upon the HM Table and Sprague's Select Tables. Interest, 4 per cent.

Age at Entry.	HM.	Sprague Select.
20, . . .	1·245	1·391
30, . . .	1·669	1·714
40, . . .	2·352	2·361
50, . . .	3·542	3·488
60, . . .	5·715	5·541
70, . . .	9·866	9·353

Let us now observe the influence of the HM Table upon the reserves—*i.e.*, how it affects the liabilities in the periodical actuarial investigations. It may interest you to know that the severity of the reserves, or the measure of the liabilities, has tended to increase, in respect of the tables reviewed, in the order in which they have been considered; or, what is tantamount thereto, in precisely the same order in which they were published. As you will recollect, I informed you that the Northampton Table produced the smallest reserves; and now we have under review the table which produces the largest reserves—the reserves resulting from the employment of the other tables which we have dissected occupying an intermediate position, and representing a steady advance in this respect, and according to the order in which they were reviewed.

It may be of further interest for me to explain, as indicating the popularity of the HM Table for the purpose of estimating the liabilities of Life Assurance Offices, that, according to the returns deposited with the Board of Trade in pursuance of the requirements of the Life Assurance Companies Act of 1870, no fewer than 79 British Offices employ the Healthy Males Table, 24 of which also employ the HM (5) in combination with it.

A great many of our Colonial Offices also adopt this table as the best measure of the mortality likely to prevail among insured lives, and as affording the most accurate instrument to measure the liabilities.

I may also state that the Dominion Insurance Department of Canada value the policies of all Companies transacting business there every quinquennium on the basis of the Healthy Males Table, combined with interest at 4½ per cent.

Of course, it must be obvious to you that a table evolved from so large a mass of statistics must represent a very correct criterion of the mortality incident to medically-selected lives; and, of course, the lives on the records of our Insurance Companies, as you are well aware, have to undergo a very severe test prior to the proposal being accepted. The appended table affords an indication of the operation of the HM Table in relation to the reserves, and substantiates the assertions which I have made respecting this table.

TABLE of Reserves in respect of £100 Policies, based on the HM Table. Interest, 3 per cent.

Age at Entry.	Rate of Mortality.	Expectation of Life.	Value of a Policy at the end of		
			5 Years.	10 Years.	15 Years.
20, . .	·00633	42·06	4·360	9·440	14·996
30, . .	·00772	34·68	6·135	12·897	20·481
40, . .	·01031	27·40	8·708	18·045	27·962
50, . .	·01595	20·31	12·100	24·573	36·777
60, . .	·02968	13·83	16·180	31·857	46·053

In conclusion, I ought to explain that the tables adduced in this contribution, to indicate the magnitude of the reserves evolved by the employment of the mortality tables reviewed, have been compiled on the hypothesis that the contracts are subject to yearly premiums; and that, in each case, a premium had just fallen due, and was outstanding at the epoch to which the computation relates.

W. H. ALDCROFT, F.I.A.

Insurance Institute of Manchester,
20*th March,* 1900.

PHTHISIS IN RELATION TO LIFE ASSURANCE.

Dr. Ransom prefaced his remarks by saying that he thanked them most heartily for the honour they had done him in asking him to open the discussion. When he was approached by the secretary, he accepted the invitation with particular pleasure, for the coming into closer contact of the medical examiners and the gentlemen connected with the actuarial side of Life Insurance could not but be of advantage to both sides. Medical men, fortunately, had nothing to do with the business side of Insurance, but had certain things in common with actuaries. They all wished to enable the offices which they served to avoid dangerous risks, and also wished them not to have to reject risks that might fairly be estimated and accepted under certain terms. Then they had their duty to those of the public that desired such a laudable object as Life Insurance. It was their duty to see that people were not unfairly rejected or unduly rated. He himself, and many other medical examiners, felt that they could learn a great deal from the actuaries—perhaps more than the latter could learn from them; but he must confess that although he had been engaged in Insurance work for ten years, he had learned but little from that work, because he never heard the result of his prophecies. It would be of great benefit to the provincial medical officers if the recommendation of the chief medical officer in London, and the decision of the directors in each case, were communicated to them. At the head office they had statistics extending back over a great many years, which they in the provinces had not, and therefore could form a much better judgment. Especially when the proposer died within a few years of being accepted should the medical examiner be informed and a copy of his report sent him.

Dr. Ransom then proceeded to deal with his subject—"Phthisis in Relation to Insurance." He said that as he was speaking to a non-medical audience, he would first define a few terms. The word tuberculosis was the medical term signifying consumptive

disease in any part of the body. Phthisis was ordinary consumption of the lungs. Of the enormous importance of tuberculosis to the community at large, and especially to Life Assurance societies, there was no need to insist. Over 70,000 people died of it annually in the British Isles, while probably 40 per cent. of those who attained old age suffered from some form at some time in their lives. It caused at least 10 per cent. of the deaths in all the capitals in the world, and as many in this city and county. Within the last twenty-one years their views of the cause and the natural history and treatment of this disease had undergone great changes, and it clearly behoved the Life Assurance companies to reconsider their position, and to inquire whether the policy based on the knowledge of twenty or more years ago still held good. A malady which in the former period was spoken of as essentially hereditary and as usually brought on by exposure to cold, which was treated with warmth and seclusion from even the mildest zephyr that blew, the issue of which was considered almost inevitably hopeless, was now classed in the group of infectious diseases; was known to abound in hot as in temperate climates, while it may be absent in cold ones; was known to depend not on heat or cold, but on impurity of air, overcrowding, and the enervating influences of indoor life; while it was best treated by a free exposure to outdoor air, warm or cool, and was best guarded against by a life of fearless exposure to the elements. They, moreover knew that the majority of persons attacked by tuberculosis recovered. From one-third to one-half of them, knowingly or unwittingly, were attacked, but only about one-tenth of those who died succumbed to this disease. The indisputable fact that several members of a family often died of phthisis was explained by some advocates of the new doctrines by the supposition of personal contagion, or by the theory that the infection lurked about the house. If they read only the writings of the extreme conservatives and extreme progressives they were confronted with opinions apparently irreconcilable. Thus Dr. Pollock said in 1898:— "There is no doubt whatever from clinical evidence that consumption is in a large number of cases a hereditary—a transmitted—disease." Dr. Theodore Williams "admits that there is such a thing as contagion, but cannot see how we can set aside the overwhelming evidence in favour of heredity having a distinct effect." On the other hand, Dr. Heron thinks that the "evidence of infection we now have strikes at the foundation on which has been

built the theory of hereditary tendency to tuberculosis," and would accept at ordinary rates a proposer of good physique, not living in an infected house, although he gave a family history of consumption. Mr. Thorburn said "our knowledge of the infective nature of tuberculosis removes our presumption of its heredity." Clearly authorities differ, and statistics pointed in diverse directions. Let them look themselves at facts and trace truth to its hiding-place.

Their real understanding of tuberculosis dated from the time when Koch first discovered the now oft-mentioned tubercle bacillus. He found that in all organs affected with tuberculosis a very minute rod-shaped fungus—called a bacillus—was present; and he was able to cultivate this bacillus by itself outside the body, and then produce tuberculosis by injecting it into animals, or letting them inhale it into their lungs. It was now universally admitted by competent observers that tuberculosis was always caused by this bacillus, and that unless it got into their system, whatever their family history or their mode of life, they could not have consumption. Consumption was thus proved to be a disease produced by infection from without. These bacilli occurred by thousands in the phlegm spat up by consumptive patients, and when this phlegm dried on the floor or a handkerchief, it was obvious that they might get into the dust of the air, and be breathed by other persons, or swallowed with food on which dust might settle. It was also known that these bacilli might live for many weeks, especially in dark and damp rooms, and grow on wall-paper wet with the vapour of condensed breath. A striking instance of the danger of bacilli in the air was afforded by the case of a German laboratory servant, who (against advice) went into the cage of dogs into which a fine spray of consumptive phlegm had been blown, and died soon afterwards of galloping consumption. That actual infection from consumptive persons did occur had been shown in many cases. Sir Hermann Weber told how nine husbands, consumptive before marriage, lost from their disease 18 wives—one losing four in succession—all of the women but one being free from family taint. Another story was recorded some years ago in a medical journal of a sailor who, so long as he kept at sea, although slightly consumptive, remained fairly well. He lost in succession two wives from consumption, and married a third. Afterwards he broke his leg. He was, therefore, unable to stay

at sea, and soon after he returned home he succumbed to the disease and died, his third wife surviving him. In another case no fewer than ten babies were infected by a consumptive midwife blowing down their mouths.

Having cited several other cases, Dr. Ransom went on to say that another frequent source of infection was the milk of cows affected with tuberculous disease of the udder. Consumption was very common among stall-fed cows (30 per cent. or more), and when the udder was diseased the milk contained bacilli and might infect persons—especially children—who drank it unboiled. A teaspoonful of such milk injected into a guinea-pig caused it to die in a few week of general tuberculosis. No more need be said to prove that at times consumption was caught by infection from human beings or animals.

Let them next ask to what extent this occured in daily life; how far was infection as a cause of consumption of practical importance. That it was not infectious in the way that measles and scarlet fever were, must be admitted at once, and many facts showed that infection only took place under certain conditions, which were, or ought to be, controllable. Thus, if the infectivity of phthisis were high, the nurses and residents of a consumption hospital ought often to take it; yet during 37 years at the Brompton Hospital, out of nearly 200 male and female residents only seven developed consumption, and generally it might be said that in a well-managed hospital, where air and light were freely admitted, where the patients were made to cough into proper spittoons, and the phlegm destroyed without drying into dust, and where dust and dirt were scrupulously removed, it was rare for doctors and nurses to get it. In the villages in Germany, where large sanatoria had been built for the open-air treatment of phthisis, the death-rate from consumption of the inhabitants had decreased instead of increased, showing that these large institutions were no danger to the community. Moreover, most of them knew cases where either a husband or a wife was phthisical, while the other remained healthy.

Phthisis was caused by the tubercle bacillus; but clearly many people were exposed to the attack of the bacillus without contracting the disease. In speaking of the cause of consumption, they must consider other factors. Of these, two were of overwhelming importance. The first might be called "environment," including residence, occupation, food, and habits generally.

The second was hereditary tendency. With regard to environment, he had already said that phthisis might occur in all climates. It was found in London and Rome, in Greenland and Egypt, in Canada and Jamaica, in Africa and India. It developed sooner or later wherever men congregated in cities, as was shown by its increase in Australia, and it was rare where they lived mainly out of doors, no matter whether the climate be hot or cold, wet or dry.

In England and in the States of Europe, those who habitually breathe air rendered impure by overcrowding or by defective ventilation furnish most of the victims. Thus the factory hands of the Lancashire towns, Birmingham, Nottingham, the tailors and dressmakers of London, and all large cities, are especially liable to consumption. It has been shown that even hawkers, who stand about in the street exposed to all the inclemencies of the weather, suffer less than men employed in workshops. The Derbyshire and Nottinghamshire miners, on the other hand, though they inhale much coal-dust, do not so much rebreathe the breath of others, and are nearly as free from the disease as clergymen.

The following table shows the relative mortality from consumption of persons whose occupations expose them in varying degrees to impure air :—

Agriculturist	106
Lace Manufacturer	160
Hosiery Manufacturer	190
Commercial Clerk	218
Tailor	271
Printer	326

The poorer inhabitants of our country villages suffer more than they ought from consumption, owing to the way in which they are often crowded in small cottages, the windows of which their fears of "a draught" prevent ever being opened. It is no rare thing for three or four persons to sleep in one small room with the windows shut, and the chimney stuffed up, thus breathing all the night air saturated with poison, which undoes all the good of their day in the fields. The women, who are more indoors, suffer more than the men. Still there is a marked difference between the workers in towns and the labourers in the country. The effect of free ventilation was well shown in the case of the Foot Guards, who, in spite of being picked men and of having good food and every

care to keep them warm, used to die at twice the rate of the civil population, until the Royal Commission of 1858 gave them a much larger air space and better ventilation in their barracks, since when they have had comparatively few deaths from consumption. The same has been found in prisons. Thus in an ill-ventilated prison in Vienna over fifty out of every thousand prisoners died of phthisis, while in another well-ventilated gaol the death-rate was less than 8 per 1,000. Further figures would only emphasise the fact that the liability to consumption depends mainly upon the impurity of the air. Dr. Guy had found that of 104 compositors, with less than 500 cubic feet per head, thirteen spat blood and thirteen had catarrh; of 115 men with 500-600 cubic feet, five spat blood and four had catarrh; and that of 101 with over 600 cubic feet, four spat blood and two had catarrh. They would quite see that the crowding of people into close rooms or workshops poisoned the system and sapped the strength, so that they could no longer resist disease germs that might be present; and also that if in such a room or shop there were a consumptive spitting up phlegm, the number of tubercle bacilli that the others were forced to inhale would be much larger than in a well-ventilated or outdoor place.

Under the heading of "food" he would only say that insufficient nourishment undoubtedly lessened the resistance to consumption, and that alcoholic excess still more predisposed to the disease, as witness the mortality among London innkeepers and servants, which was 10 to 1 as compared with that of parsons. But these faults alone would not suffice, for the ill-nourished and ill-clothed fishermen of the Hebrides were singularly free, while the miners of our own county and Derbyshire, who could not be called abstemious, were nearly as good lives as the parsons. With regard to clothing, he would venture to say that the more a man wore the more liable was he to get consumption.

He had said enough to show of what vast importance in relation to a man's liability to phthisis was his environment, his mode of life. They had seen that the conditions of life and work of the bulk of the dwellers in their great cities were a potent cause of consumption, and that wherever people were crowded together, so as to breathe and re-breathe vitiated air, the disease was rife. A life in the open air, even if cold or wet, was, on the other hand, the chief preventive of consumption.

That phthisis was a hereditary disease was an old, and

until lately the most generally accepted doctrine, and that "consumption runs in families" was a belief based upon the general experience of mankind. They all knew of families in which one member after another succumbed to what seemed to be their doom; and Life Assurance offices had always considered a family history of phthisis one of the most dangerous of risks—especially dangerous because, unlike gout or cancer, it killed most in early manhood rather than lopping off a few years from the end of life. It should, however, be pointed out that "hereditary phthisis" and "a hereditary tendency to phthisis" were not one and the same thing, and it was to be regretted that some eminent medical men of the older school frequently used the former expression, when, to the best of his belief, they really meant the latter. By hereditary phthisis they should mean that the child was born with the disease or the seeds (*i.e.*, the bacilli) of the disease already in its system. That either of these events occurred, except as the greatest possible rarity, he absolutely denied. So far as he could learn only two cases had ever been described of infants showing signs of tuberculosis at birth, and there was absolutely no evidence that bacilli were present in the new-born babe in cases which died within the first year of life. The great rarity of tuberculosis in the first three months of life argued against this view, while the great probability of infection from the milk of tuberculous cows fully explained later infant mortality.

Hereditary tendency was, however, another question. It might well be that certain people were born with an unusual susceptibility to the attacks of the tubercle bacillus—a certain lack of resistance to this particular germ, just as some inherited a tendency to gout—a lack of resistance to port; some to obesity, others to epilepsy or mental disease. For this view there was much to be said; but some of the evidence even for this view had been weakened by the discovery of the spread of phthisis by infection; for it was obvious that if one member of a family developed consumption, the others living in intimate contact with him would be exposed to the contagion, and might also be rendered susceptible by the same unhygienic conditions of life which made the first one succumb. Undoubtedly many instances of family phthisis depended upon infection. But, after allowing for this, he had no hesitation in accepting the common belief that members of certain families were more liable than others to contract

phthisis. Instances not a few were known of such persons who had long ceased to live together developing the disease. Dr. Theodore Williams gave a striking instance of a family in which, of six children, four died of phthisis in different parts of the world, although they had left home early.

Another case had been given by Sir Hermann Weber. A father and mother died of phthisis, and one child of tuberculous meningitis. The six other children were sent to the Silesian mountains, and grew up healthy. The eldest, after a university career, read too hard, and burned the midnight oil, and died of phthisis. Another of them tired of farming, and came to a London office, and died of the disease in two years. The others were alive and healthy eight years later. Moreover, continued Dr. Ransom, most doctors knew the slender, flat-chested young man and woman, with long eyelashes, and often of delicate beauty, in whom no signs of disease existed, but whose parents had suffered, and who he knew under unfavourable conditions would fall an early victim.

Numerous statistical inquiries as to the frequency of a family history of phthisis in patients suffering from that disease had been made. The results had varied somewhat, partly according to the number of relations investigated; but he thought they might take it as true that in about 30 per cent. of cases of phthisis some relative in the same or the preceding generation had been known to be affected. Here, however, they should note a fact previously stated—that *post-mortem* examinations (4000) had shown 40 per cent. of all people to have been at some time in their lives attacked by tuberculosis, although only 10 or 12 per cent. died of it. From this it might be said that consumptives gave a smaller family history of the disease than non-consumptives, and that phthisis in an ancestor made them less instead of more susceptible. That this was a fallacy would be seen if they remembered that a "family history" of phthisis usually meant that the persons had died of it or, at least, had been seriously ill; whereas the *post-mortem* figures showed that 30 per cent. at least of them might be attacked by tuberculosis, perhaps without knowing it, or without being very ill, and, at any rate, getting quite well. Most men were liable to an attack, but most of those attacked recovered. They might sum up by saying that from one-third to one-half of all men passed through an attack of tuberculosis, but only one-tenth died of it. Consumptive families differed from others in the weakness of their defence, in their lack of resistance when

attacked. Therefore, they concluded that the old practice of Life Assurance offices in exacting an extra premium from proposers with a family in the history of which phthisis was proved was on a basis of truth.

It remained to inquire whether the extra risk had been in the past rightly estimated, and he thought they would find from their present better knowledge of the nature of phthisis that the tendency had been to exaggerate those risks, and that it would be possible in future to lessen the premium demanded.

In every proposal for Life Assurance there were three factors to consider:—(1) Personal condition; (2) mode of life and environment; and (3) hereditary tendency; and he submitted with regard to phthisis that their importance was in the order given. Twenty years ago probably most medical men would have altered this order and put No. 3 before No. 2, if not on a level with No. 1.

The question of family phthisis was most carefully gone into by Dr. Reginald Thompson in a book published in 1884. Many interesting points, to which time would not allow him to refer, were brought out in this book, but being read in the light of their present knowledge, did not, he ventured to think, support all his conclusions. Dr. Thompson would reject all applicants with a family history of phthisis who were under 25 years of age, and for later years gave a rather complicated scale of extra rating, varying according to the number of relations affected. Slightly less onerous was the scale presented in 1882 to the British Life Association by Dr. Little, Dr. Benjamin Ward Richardson, Mr. Savory, and Mr. Wakley. They "advised the addition of ten years to the age of a proposer in his 30th year, should one of his parents have died of tuberculosis; in his 35th year he was to have seven years added to his age; and above 35 he was to be taken at ordinary rates. A man under 40, whose parents had both died of tuberculosis, was to be declined; a proposer in his 35th year was to have seven years added to his age if a quarter of the number of his brothers and sisters had died of tuberculosis; and if one-half of them had died of that disease, he was to have ten years added to his 35. The death of two-thirds of his brethren from this cause was to ensure his rejection. If one parent and a fourth of the proposer's brothers and sisters had died of tuberculosis, double rates were to be charged, and he was to be declined if one of his parents and more than a quarter

of his brethren had been killed by that disease." Dr. Pollock gave it as a rule of some offices that if two members of a family had died of phthisis, the life was declined unless the proposer was over 40, and if one parent was consumptive and the proposer was under 35, would add 10s. per cent. Dr. Buck, of New York, would accept no one under 30 who had lost one parent from consumption, and none under 45 if both had died of it—if, indeed, any such case should be taken.

On the other hand, Dr. Symes Thompson, of the Equity and Law, and Dr. Sprague, of the Scottish Equitable, though they thought that an extra premium was necessary, stated that the extra demanded had been a good deal more than necessary. Dr. Lyon, at the Mutual Life Office, investigated a thousand apparently good lives giving a family history of phthisis, and found an extra mortality of about five years, and he (the speaker) believed Mr. Manly came to a similar result. On the other hand, a German actuary who went into the figures of the National Life Office concluded that there was no extra risk. And Dr. Marsh, of the Mutual of New York, after studying the records of 1,994 cases, said—"When the proposer is of robust physical appearance, with a weight equal to the standard given in our tables, he may be accepted, notwithstanding any taint in the record of his family." Dr. Heron, of the Mutual Life Association of Australia, would exempt from extra rating a proposer who, except for a family history of phthisis, would be put in the first class.

He (Dr. Ransom) was not going to try to give them from his own experience a mathematical statement of the number of years to be added for each relative who had died of consumption. They would probably agree with him that it was not, with their present knowledge, possible to formulate such a table. The case of each proposer must be taken on its own all-round merits. Firstly, they considered the proposer's present physical position—whether he be well nourished, muscular, with plenty of good blood, had a well-shaped chest that expanded freely and had no signs of present or past disease in his lungs, or of past tuberculous trouble in the bones, skin or elsewhere. Next they noted carefully his *past history*, whether he had been liable to colds or cough, had ever had pleurisy—and this was most important, for probably most cases of pleurisy were tuberculous; whether his personal history betrayed any likelihood of having had tuberculous disease of any other organs

(*e.g.*, case of tubercle of tonsil or kidney), and whether his past history showed a fairly good resistance to disease generally. Thirdly, his *mode of life and environment* were investigated—whether he was regular and temperate in his personal habits, whether his residence and work were healthy and bracing, affording abundance of fresh air, or whether they were such as to expose him to the contagion of tuberculosis and to the generally depressing influences of bad air, prolonged indoor work, poor food, and lack of exercise. In this connection they must remember that the tubercle bacillus was almost ubiquitous, and that in the dust of our offices, factories, shops, theatres, churches, lecture halls, tramcars, and railway carriages, as well as in many private houses, was sure to be frequently present in smaller or greater numbers. Those of them who led city lives were bound to inhale tubercle bacilli occasionally, and in the case of a proposer for Life Assurance they must consider how far his domestic and business life exposed him to this infection, and how far hard work, worry, and the vitiated atmosphere of his warehouse or office, by sapping his vitality, were likely to decrease his powers of battling with the infective agent. These considerations, of course, applied to all men and women, but with greater force to those who had lost parents or near relatives from consumption, and who, probably, were more susceptible than the average to the disease. But if the result of these inquiries were satisfactory, if he found a proposer with a sound, vigorous body, free from history of disease, leading a healthy, active outdoor life, not frequenting and not likely to frequent hotbeds of infection, he would accept him for Insurance though he were under 25 and both his parents had died of consumption. If he could feel sure that his common-sense and means were sufficient to guarantee his persisting in the above-mentioned healthy life, he (Dr. Ransom) thought he would accept him at ordinary rates; but such was the uncertainty of human affairs that it would probably in most cases be prudent to add some extra premium, the amount to depend partly on the extent of the family proclivity, but also largely on the probability of the continuance of the suitable life. In such cases he thought the agent and the medical examiner might well co-operate more than they usually did, and it should be the task of the agent to make minute and careful inquiries into all the conditions of the proposer's life, and to report to the doctor thereon.

He had taken an extreme case: both parents, and a man at the most susceptible age; but the same principles applied where the family susceptibility seemed less and the age was greater. After 45 or 50 hereditary tendency played but little part, being most marked from 15 to 30 in both sexes. Hence the general custom of Insurance offices in loading proposers less who approached the forties. If the proposer of 25 had not the robust form he (Dr. Ransom) had depicted, if his weight were below the average, his colour pale, his muscles soft, and his chest expansion poor, a family history of phthisis would certainly warrant an addition to the premium, though he showed no signs of disease. Still more, if his habits were sedentary, his life spent in the confinement of a city office, a tailor's workroom, a lace factory, or, still worse, in a slum public-house, the risk became serious. He did not think that he would take at any cost a Sneinton publican who has lost father and mother from phthisis. A working tailor or dressmaker, or a lace or hosiery operative, or a Board School teacher, would be almost as bad a life. Warehousemen, clerks, and shopkeepers might be a trifle better, but the latter varied much in the conditions of their work. He fancied drapers were the worst and butchers the best, the latter being practically always in the open air. Some manufacturers and merchants worked in surroundings as unwholesome as did their employés, but, generally, the employer could secure better ventilation for his own office, and arrange for more outdoor exercise, besides living in a better house. The same applied to such persons as lawyers, accountants, and architects. Doctors came off better than might be expected, seeing their necessarily frequent exposure to contagion, and their harassing life. Probably their being out of doors so much on their rounds protected them. Still, doctors did suffer, and he should look with suspicion on the chances of a young doctor of slender frame and a family taint of phthisis, whose practice lay in a poor part of a town like Nottingham. The same man in a rural district might be a fairly good life.

He had said enough to show how important, in his opinion, was environment, or mode of life. It was of importance to all people, but preponderatingly so to persons in whose family there seemed to be a special susceptibility to consumption. Heredity and environment must always be considered together, but in phthisis environment should come first in receiving attention

from Insurance offices. The time would, he hoped, come, as Life Insurance became more general, when Life offices would copy the Fire offices and insist on regulating the risks they were asked to pay for. They would not take a fire risk without inspection of the premises and approving its structure, its heating and lighting arrangements. No more ought they to insure the lives of numbers of people without having a voice in the protection of their lives. Better than State control would be the influence of the Insurance Company, and the assistants of our modern gigantic shops, the city clerks and warehousemen, would be better lives for the companies and for themselves if the companies' inspectors were to insist on proper ventilation, drainage, and sleeping accommodation in these shops and warehouses. The scheme might perhaps seem Utopian, but the Insurance companies were a power in the land, and ought to grow yet stronger.

So far they had considered the case of a proposer who had about him no signs of present or past tubercular disease. What were they to do if the personal history or medical examination revealed such? He thought all medical men and actuaries would agree that any active tuberculous disease was an insuperable bar to insurance. They need, therefore, only touch upon evidences of past trouble. First, let them take pleurisy. So called "simple pleurisy" had in the past been looked upon as a relatively slight affection, due to "catching cold," and usually recovered from without leaving permanent weakness. As a consequence, pleurisy was rarely included among the illnesses about which a proposer for Life Assurance was specially questioned. For some time, however, evidence had accumulated that pleurisy was in a very large number of cases of tuberculous origin. Thus Ziemssen had said that of adults who had lived through a chronic pleurisy nearly one-half died of tubercle. Bowditch found that out of 49 private patients who had had pleurisy between 1849 and 1869, no less than 22 had by 1889 died from phthisis; and a German observer (Aschoff) who inoculated guinea-pigs with the fluid obtained by tapping cases of "simple" pleurisy found that 75 per cent. of these animals died from tuberculosis. His (Dr. Ransom's) own experience bore this out. Hence he entirely agreed with Dr. Hector Mackenzie, who had carefully investigated the matter, that pleurisy added gravely to the risk, especially in cases with a family history of phthisis. In such a case, should any remains of the pleurisy—such as retraction of the lung—be detected, the life

would only be accepted with a considerable addition, and, as Dr. Mackenzie said, "only in the case where the family history is unimpeachable, the personal history good, apart from the pleurisy, the examination thoroughly satisfactory, and over seven years have elapsed since the attack, would it be safe to accept the life at the ordinary rates." To this he would add that the proposer's environment, as before defined, must be satisfactory.

It would be out of place, before a non-medical audience, to discuss minutely the bearing of all the possible lessons of former attacks of phthisis on the expectation of life, especially as he did not think it possible to lay down general laws on the subject, but a few points might be mentioned. He did not think he would accept on any terms any one who had shown signs of phthisis until he had been free from all symptoms of active disease for at least five years and had reached the age of 30, or of 40 if he had a marked family history of phthisis. If a man of good family history were over 30, had had no symptoms for five years, and if the lungs on examination showed nothing but a slight consolidation at one apex, and if he were leading an entirely suitable life, he might be taken with an addition, which would be less the older he was. In such a case it might be well to insist on all the premiums being paid in a limited number of years, or to put on a considerable load for the first few years, and to decrease it as age advanced. Another method of meeting the risk was by the deduction policy, by which, if the proposer died of phthisis in the first year, a considerable amount was deducted from the sum payable to his heirs, and a gradually smaller deduction made year by year until, after a time, they got the full amount. As the risk was nearly all in the first few years, an endowment policy was of no use. Similar terms were, of course, applicable to a man who was himself healthy, but had a bad family history, or whose environment was dangerous. A history of hæmoptysis, or spitting of blood, whether in the family or the individual, had been considered by writers on Life Insurance a peculiarly bad sign, needing extra precautions, as it was said the disease ran a more rapid course in such families. He was, however, not convinced of the truth of this. Indeed, in some cases an early hæmoptysis, occurring before there were any marked signs of disease, might save life by acting as the red flag, or danger signal, and frightening the patient out of an improper into a proper and hygienic life. A history of hæmoptysis was, therefore, not an absolute bar to Insurance.

Consumption was popularly divided into a first, a second, and a third stage, a classification which partly corresponded to the truth, and they might naturally ask, Is a man in the third stage insurable? They had already agreed that no case of consumption was insurable unless the disease had been arrested for at least five years. The disease might be arrested in any of the three stages, even in the third or "cavity" stage—when the tuberculous process had eaten out holes in the lung—and he would reply that even in this stage, if the disease were limited in extent, if at least ten years had elapsed since there were any signs of active disease, and if the proposer were over 45 years of age and his mode of life adapted to his constitution, he might be accepted with an addition. Dr. Symes Thompson, of the "Equity and Law" office, had reported an interesting case of a man who had been refused in 1857 for hæmoptysis, and had signs of cavity, being accepted (with extras) in 1888 and 1895, and proved a profitable case for the office. There was no doubt that cases, both of hæmoptysis and cavity, did occasionally attain old age. Though a cavity was risky, it was not so much the stage of the disease as the completeness and duration of its arrest, which was of importance to the expectation of life.

Among proposers who has passed through an attack of phthisis women needed special consideration, and it was probably not too much to say that no woman who had once shown signs of the disease should be accepted until she had passed the child-bearing period of life—unless, indeed, she could give a guarantee of celibacy—so apt was the mischief to light up afresh during the times of lying-in and suckling. For the same reason a healthy young woman with a strong family history of consumption would need a larger load than a young man. After 50 women were probably better lives than men, and, according to Dr. Reginald Thompson, hereditary tendency with them then ceased to have any effect. Susceptibility to phthisis began earlier with girls than with boys.

Time would not allow him to dwell on the bearing of signs of old tuberculous lesions elsewhere than in the lungs, *e.g.*, in the glands, skin, bones, etc. They had not all the same importance. For instance, a few scars of old scrofulous glands, or a patch of healed lupus, were probably less serious than disease of the bones, joints, or bowels; but they all increased the probability of the development of phthisis or other form of tuberculosis,

and all should be carefully sought for, both in the personal history and the medical examination.

In conclusion, if they asked him what was the moral of his paper, he would say that, putting aside the all-important element of personal condition, they had had to consider three important factors—the infective agent (tubercle bacillus), heredity, and environment, the most important of which, for the expectation of life, was the last. Environment was important for the prevention of consumption; it was important for its cure. He had already suggested that Insurance companies might find it worth their while to reduce the liability to consumption of their policy-holders by influencing their conditions of life. The future might also see the sphere of action of the companies extending to the environment of those who were actually affected with the disease. This had already for some years been done in Germany in connection with societies which insured against sickness. In Germany, insurance against sickness and old age was compulsory for all whose incomes were below £150 a year. The Insurance companies found it paid them to erect and maintain institutions called sanatoria, where they kept those who developed symptoms of phthisis in pure country air, resting from harmful work, and fed with abundance of wholesome food, until the disease was so far cured as to enable them to return to their occupations. What belief German business men had in this treatment was shown by the statement that in 1898 over £150,000 were spent in this way. Various statistics gave about 70 per cent. as the proportion of persons restored to their working capacity, although he did not think there was yet adequate information as to the duration of the cure after the patients had returned to their former work and life. Thus the agents of the Hanseatic Insurance Office found in full work in 1898 72·8 per cent. of those treated a year earlier, 65·6 per cent. of those treated in 1896, 48·7 per cent. of those of 1895, and 37·7 per cent. of those in 1894. He did not bring forward these facts relating to the much-discussed "open-air treatment" of phthisis to prove that this treatment could so harden a patient as to make it safe for him to go back to a dangerous trade; but they were evidence of the real value of a fresh-air life in arresting as well as preventing consumption, and they did suggest the possibility of Life as well as Sickness Insurance societies finding it worth their while to assist the cure of their phthisical policy-holders, and

to exercise a beneficial control over their subsequent work and mode of life. That such a scheme presented difficulties he fully admitted, and also admitted that in Life Assurance its limitations were greater than in assurance against illness; but he was one of those who believed that both forms of insurance had a large field for future development, included in which might be found plans for the prolongation of life as well as compensation for death.

W. B. RANSOM, M.D., F.R.C.P.

Nottingham Insurance Institute,
2nd February, 1900.

EXTRA PREMIUMS FOR LIFE ASSURANCE.

"EXTRA Premiums for Life Assurance" is so wide a subject that it is impossible for me in the time at my disposal to do more than briefly refer to its leading headings, and give the most important results and conclusions arrived at by the many able men who have dealt with one or other of these branches.

As a preliminary matter, I ought, I think, to clear the ground by meeting the objection of those who consider that there is no occasion for any extra premiums at all. Their argument is that, if Life Offices insured every applicant at rates based on the average mortality of the whole kingdom, they would be quite safe. This would be true if everyone, or, say, all the adult males in the kingdom, made proposals for policies, and if the amounts insured on the good lives were as large as on the bad ones. But this is very far from being the case in ordinary life insurance. The greatest of our Ordinary Life Offices have only a few tens of thousands of lives insured, and experience shows that under-average lives are (as we should expect) more anxious to get insured than ordinary men—and for larger amounts. This self-selection against the Companies is so strong that, unless an Office took means to protect itself, it would have swarms of bad lives entering it, and as such business increased, the insurances on good lives would fall off. Many of the younger good lives would surrender their policies or allow them to lapse and take new ones out elsewhere, while their places would not be filled by fresh lives of the same class. This objection to accepting all lives at the same rate does not apply to Industrial Life Offices, in which the number of lives insured is very much greater, but even here the Companies, though they have no medical examination,* must protect themselves, and they

* As pointed out by Mr. J. S. Leslie in the discussion which followed the reading of the paper, this statement requires qualification. It is applicable to the great majority of Industrial Policies, but not to the larger cases.

do so not only by the exercise of a wise discrimination on the part of their superintendents and collectors, by whom an obviously bad life would be rejected, but also by the usual provision that the insured shall not come into "full benefit," except as regards the risk of death from accident, until after the lapse of twelve months from entrance.

Under-Average Lives.

The most usual extra premium is the "rating-up" for a life which is found to be below the average standard, either personally or as regards the family history, and by far the commonest cause for "rating-up" is a consumptive family history. An investigation made a few years ago by Mr. H. W. Manly, President of the Institute of Actuaries, and Manager of the Equitable Life Office, in conjunction with Dr. J. Glover Lyon, Assistant Physician to the Victoria Park Chest Hospital, London, shows that, where one parent has died of consumption, an addition of 3 to 4 or 5 years of age would cover the extra risk, while for endowment assurances the required addition would be 2s. to the premium for an assurance at 45 or death, 3s. for 50 or death, 3s. 6d. for 55 or death, 4s. for 60 or death, and 5s. for 65 or death. Some Offices absolutely decline all cases where there is evidence of two cases of consumption in the family, but facts do not justify this rule. All that is required in such cases is increased caution on the part of the Medical Officer. Dr. Lyon gives the following table of comparison of the death-rate from consumption in three Life Offices with that in the Registrar-General's Report. (Supplement 1885.)

Age at Death.	Deaths per 1000 per Annum.	
	Insurance Offices.	Registrar-General.
20—24	2·05	3·
25—34	2·29	3·
35—44	2·28	4·12
45—54	1·93	3·86
55—64	1·79	3·19

It thus appears that, so far as the general population is concerned, most deaths from consumption take place in the ten

years 35-44, and in the following ten years. This is quite at variance not only with the popular opinion, but with the views which were until recently entertained by the majority of medical men. From the same Report by the Registrar-General, it appears that the percentage of children dying of consumption is very small. To show how erroneous conclusions are apt to be drawn when founded on medical experience alone, Dr. Lyon quotes the following from a standard medical text-book published before 1885:—"No age is free from liability to tuberculosis; it is extremely common in young children; but putting these on one side, the age of greatest liability is from 20 to 30 or 35."

Mr. J. M. Low, F.F.A., Manager of the Edinburgh Life Assurance Company, read a paper in July, 1898, to the Section in Medicine in relation to Life Assurance at the 66th Annual Meeting of the British Medical Association on "Extra Rating as a Statistical Problem." He gives a table exhibiting the causes of 74 deaths among 587 obese persons, which shows that not a single death occurred from consumption, while 8 deaths from that cause might be expected among ordinary assured lives. The deaths among the corpulent people were altogether 10 per cent. above the expectation, the excess being mainly from diseases of the digestive and urinary organs. It is interesting to note that statistics fully justify the opinion deeply rooted in the popular mind, and entertained by medical men generally, as to the immunity of fat men from consumption. An American Life Office, the "Washington," issued its "Death Experiences" in 1890, which show that in the case of a life with a tendency to consumption, the percentage of deaths from consumption was only 6·13 when the weight of the assured was above the standard; that it was 27·27 when the weight was at the standard, but 48·39 when the weight was under the standard. It is quite clear, therefore, that weight as compared with height is a factor of the very highest importance in estimating the eligibility of a life with a predisposition towards consumption.

The "Washington's" figures further show that, of the deaths from consumption, there occurred:—

10·90	per cent.	in the	1st year of Insurance.
22·47	"	"	2nd " "
24·18	"	"	3rd to 5th year of Insurance.
17·36	"	"	6th to 10th " "
13·94	"	"	above the 10th year of "

These figures indicate that, in the case of lives with a consumptive tendency, medical examination is of little or no avail beyond the first year. The Report confirms Mr. Manly's conclusion that consumption in the parents is of greater importance than amongst the brothers and sisters—the rate of mortality in the former case being double the latter. Even two or more collateral deaths from consumption appear to exercise much less influence than the death of one parent. The "Washington's" figures further show that an acquired tendency to consumption alone is much worse than a hereditary tendency alone. The following are the comparisons :—

	Deaths from Consumption.
General average, - - - - - -	- 17·65 per cent.
Class I.—Hereditary tendency alone, -	- 23·41 "
Class II.—Acquired tendency alone, -	- 30·92 "
Class III.—Hereditary and acquired tendencies combined, -	- 47·73 "
Class IV.—No consumptive tendency, -	- 14·56 "

Grouping the three classes with consumptive tendencies together, their mortality from consumption is 28·35 per cent., or about double that of the class with no consumptive tendency. Sub-dividing the deaths in cases where there is an acquired taint, it appears that persons subject to asthma at the time of insurance show less than the average deaths from consumption; while those who have had spitting of blood previous to insurance exhibit an over-average percentage. Still greater, however (and this fact is of importance), is the percentage of deaths from consumption in the case of persons who at the time of insurance were subject to cough or catarrh. I hope some of the medical gentlemen present will refer to other diseases which are not infrequently the cause of additions to the premiums, such as syphilis, gout, hernia, etc.; and I will conclude this branch of my subject by referring to a paper on "Some Medical Aspects of Life Assurance" read by Dr. Leslie Ogilvie before the Actuarial Society of Edinburgh, in which he gives the following scale of the importance which should be attached to the various facts on which an opinion is based as to the eligibility of a life or as to the proper addition to be made to the premium :—

Personal History	..	..	20 per cent.
Family "	..	..	20 "
Physical Examination	..	..	30 "
Personal Appearances	..	..	20 "
Environment	..	..	10 "

In other words, his view is that personal history, family history, and personal appearance are each of them of equal importance, and should together affect the judgment to the extent of 60 per cent., while physical examination should count for only half as much as these three combined, or 30 per cent. of the whole, and environment only weigh to the extent of one-tenth of the whole. The physical examination must, of course, be entirely a matter for the Medical Officer, but all the other items are such as any experienced Insurance man should be able to form an opinion of. In assigning only 10 per cent. of the total to environment, Dr. Ogilvie would doubtless (though he does not say so) leave out of account any item of environment so prejudicial as to commonly incur a special extra, such, for example, as engagement in the liquor trade or residence in a tropical climate.

Hazardous Occupations.

Mr. J. J. M'Lauchlan, F.F.A., Secretary of the Scottish Equitable Life Office, in a paper recently read before the Actuarial Society of Edinburgh on the Mortality in certain Hazardous and Unhealthy Occupations, examines the information given in the Supplement to the Annual Report of the Registrar-General for England, issued in 1898, with a view to obtaining some guidance in fixing extra premiums for hazardous occupations. Of the causes which he states as those which principally render occupations in this country hazardous or unhealthy, by far the most important, from the point of view of an ordinary Life Office, is the "temptation to alcoholic excess." I shall therefore ask your attention for a little to the subject of the extra premiums for

Liquor-Sellers.

The most important investigation into this subject was that undertaken a few years ago by the Managers of the Associated Scottish Life Offices, as a result of which gross extras of 25s. per cent. for publicans and 20s. for hotel-keepers were recommended (in place of the 20s. for publicans and 10s. to 15s. for hotel-keepers formerly generally charged). In a paper on this investigation, Mr. Low shows that these extra rates are by no means excessive, if the ordinary methods of valuation are to be followed, and especially if the extra rate is to be remitted on the assured giving up the occupation of liquor-selling, even if in that case

evidence of continued good health and habits be required. The statistics from which these conclusions are drawn comprised all persons of the occupations named, however long they had been in the trade, and whether or not they continued in it until they passed from observation. They were all, no doubt, accepted as temperate persons and good lives of their class. Mr. Low therefore points out that if in practice any Office seeks to distinguish between, favourable and unfavourable cases in the matter of rating it must be understood that if the average rate is inapplicable to the one class, it is also inapplicable to the other. If some say, for example, that total abstainers engaged in liquor-selling should be excused from extra charge or accepted at a modified rate, the discrimination must also extend to refusing others or adding more than the usual extra rate to their premiums. This experience of the Scots Offices shows several subsidiary and important results. For example, the extra indicated by the figures and recommended by the Committee for licensed grocers in Ireland is 15s. per cent., while for the same class in Scotland it is only 10s. per cent. The cause of the difference, no doubt, is that in Scotland the licensed grocer is only permitted to sell for consumption off the premises, while in Ireland he has a bar at which drinking takes place. The mortality of female publicans appears to be remarkably favourable. The statistics support the view commonly held that the extra risk diminishes with the time during which the occupation has been followed; but we must, in this connection, bear in mind that all persons who insured as publicans, etc., are included in the Returns, whether they continued their connection with the liquor trade or not. Accordingly, as the age increases, there will be an increasing number of persons who have left the trade and who are now engaged in other and less hazardous occupations, which would, of course, reduce the rate of mortality at the higher ages.

It is instructive to peruse the treatises by the authors of previous important investigations—Mr. Stott, Mr. Wallace, Mr. Gordon Douglas, and others—in connection with the more weighty results of the Associated Offices. The necessity for caution in drawing conclusions from meagre *data* is demonstrated in the case of the statistics given by Mr. Douglas, from which the extra premium for publicans in England works out to 9s. 3d. per cent. only, while that for Scotland is 30s. 5d. In other words, the experience under his observation showed the mortality of English publicans

to be less than one-third that of Scots publicans. Accepting this result, many persons assigned as the cause the well-known fact that north of the Tweed the national drink is whisky, while in England it is beer. This appeared to be a reasonable explanation, but unfortunately it must be discarded, as the collective experience shows the extra mortality among English publicans to be fully as great as among publicans in Scotland and Ireland.

Mr. J. J. M'Lauchlan shows that according to the Registrar-General's Returns the excess of the death-rate among publicans, etc., in London and the industrial districts over that of healthy male assured lives is about double the excess of the death-rate among publicans in agricultural districts over the same standard. And taking his further comparison with males occupied in light labour without exposure, in the respective districts, the relatively favourable position of rural as compared with urban publicans still holds. Probably there is more beer as compared with whisky drunk in the agricultural districts, and perhaps the advocates of the former drink, after being so ruthlessly dislodged from their position of superiority in the English *versus* Scots comparison, may draw some comfort and support from the Registrar-General's statistics.

Butchers.

In addition to persons engaged in some branch of the liquor trade, who are alone dealt with by the other authorities I have quoted, Mr. M'Lauchlan, following Dr. Ogle, the late Superintendent of Statistics at the General Register Office, includes butchers among those engaged in occupations involving temptations to alcoholic excess. Their mortality from accident is only 68 per cent. of that among occupied males (which I regard as an astonishing fact, even taking into account that plumbism is included as an accident which increases the average for occupied males), and from diseases of the respiratory organs only 95 per cent. But under every other heading their mortality shows an excess, which in the case of alcoholism amounts to 169 per cent., in diseases of the liver to 107 per cent., and in suicide to 64 per cent. above the average.

Towards the end of last year the Actuary and Manager of a well-known London Life Office enquired of 43 other Offices as to their practice in regard to proposals on the lives of butchers.

The replies he received showed that 24 of these Offices, or more than one-half of the number, accept such proposals at the usual rate, subject to more than ordinarily careful enquiries as to habits, etc.; 3 charge an extra varying from 5s. to 20s. per cent.; 14 distinguish between masters and journeymen, or between butchers who slaughter and those who do not, taking masters or non-slaughterers at the ordinary rate, and either declining journeymen and slaughterers or charging them an extra varying from 5s. to 20s. per cent.; while 2 had little or no experience of this class of lives. Several of the Offices which charge no extra prefer to have these cases completed as Endowment Assurances, maturing at a comparatively early age. Everyone will admit that it is desirable that all Offices should aim at uniformity of practice in extra-rating common occupations, and this instance shows how far we are at present from such a desirable consummation. The Registrar-General's statistics indicate that an extra of 10s. per cent. would fully meet the additional risk in the occupation of a butcher.

War Extras.

When I consented, at the request of the Council, to take up the subject of Extra Premiums, I did not anticipate that military extras would form the section of greatest practical importance to the Insurance man at the present time. But so it is. And we shall now endeavour to gain such light as experience can throw on a question of such absorbing interest as the death risk run by our officers and men in South Africa.

Mr. T. G. Ackland, F.I.A., and Dr. A. H. Smee investigated the subject of military and naval extras a few years ago, and embodied the results in an important paper. They found that the rate of mortality in the army at home is about 5 per 1000 for commissioned officers, and between 7 and 8 per 1000 for non-commissioned officers and men, while that of the general male population of the United Kingdom between ages 20 and 50 averages 12 per 1000, and that of assured lives, as shown in the Healthy Male Table of the Institute of Actuaries Experience (1869), is about 10 per 1000. The select mortality table on the same basis, representing the mortality during the first year of assurance, gives an average annual rate of somewhat over 5 per 1000, which closely accords with the experience of officers in the

army, the medical selection as regards matters that would affect the prospects of longevity being somewhat similar in the two cases. Though the mortality of the army as a class is somewhat less than that of assured lives as a class (caused partly by the undoubtedly detrimental effect exercised in the case of assured lives by the lapse or surrender of assurances, which tends, by taking off a superior class of lives, to deteriorate the experience as a whole), the more favourable experience of the former is due entirely to the exceptionally light mortality at the earlier ages. As age progresses the difference diminishes, until ultimately the mortality of the soldiers is less favourable than that of assured lives, or even of the population generally. I should imagine that this must be due principally to the increasing number, as age progresses, of those whose prospects of longevity have been impaired by previous residence abroad. The extra mortality in the army at foreign stations in times of peace is about 7½ per 1000.

Coming now to the risks of active service, we find that, from 1872 to 1886 inclusive, the British army was engaged in small wars during 12 out of these 15 years, in which the total number engaged was 92,650, and the deaths in action 1396, or 1½ per cent. The lowest experience was in Egypt in 1885, when there was only 1 death in action out of 10,000 engaged. In the Egyptian war in 1882 the rate was 18 per 1000, but the highest rates in the small wars have been in South Africa, the rate being 25 per 1000 in 1881 and as much as 64 per 1000 in 1879.

Passing from small to national wars, amongst which latter the present South African war must of course be classed, it appears, from the investigation of Mr. W. B. Hodge, that in the 20½ years of Napoleonic wars in which this country was engaged a century ago, the total average annual mortality was nearly 6 per cent., or 60 per 1000, of which only 6·6 per 1000 arose from casualties in action, and 49·6 per 1000 from sickness, &c. In the Crimean war the British mortality was 22,182 out of 97,864 engaged, and the French 95,615 out of 300,000, equivalent to annual rates of 12·6 and 15·5 per cent. The mortality among the Russian troops was simply appalling, being estimated at 630,000, of whom only 80,000 died from wounds in battle.

In the American Civil war the deaths among the Federal troops from all causes amounted to no less than 166,623, or 7 per cent. *per annum* of the total mean strength. The Confederates raised

1,100,000 men, and the deaths are given by Mr. A. G. Mackenzie, F.F.A., F.I.A., in his valuable paper on "War Extras," at the huge figure of 500,000. The excess of mortality among the Southern troops may be attributed to the poverty of the Confederate Government, which was unable to make adequate provision for the comfort of its troops and for their proper medical attendance.

The deaths in the German army during the Franco-German war were 44,752 or just over 5 per cent. of the force engaged during the campaign of seven months. From an analysis of these deaths we find that the risk of combatant officers being killed in battle was more than $2\frac{1}{2}$ times that of the rank and file, and that the infantry was by far the most hazardous branch of the service, the risk run by a field officer in the infantry being more than twice that of a field-officer in the cavalry, and over thrice that of a field officer in the artillery. The deaths from sickness among the privates and non-commissioned officers were 1·38 per cent., against ·82 per cent. among the combatant officers, and taking the deaths from all causes the rate was 8·9 per cent. among combatant officers, against 4·5 per cent. among privates and non-commissioned officers.

In assessing an extra premium, the Offices must of course keep in view the impairment of vitality caused by hardships and wounds (and climate, when the war is in an unhealthy country), as well as the risk of actual death during the campaign. Considering the ordinary life premium sufficient to meet this risk of deterioration and setting it aside for that purpose solely, as suggested by Mr. Mackenzie, we find that an extra premium of £8 18s. per cent. would have been required to meet the risk of combatant officers during the Franco-German campaign, or at the rate of £15 5s. per cent. for 12 months, without making any allowance for expenses. For non-combatant officers the required extra would have been only 41s. per cent., but it would be unsafe to adopt this rate in practice, as the German experience was unique, among great wars, in the fact that the most of the deaths arose from wounds, barely 30 per cent. being due to disease, which is generally accountable for by far the larger share, and to which medical officers must be fully as exposed as combatant officers.

Messrs. Ackland and Smee arrive at the following conclusions :—

(1) That the home or normal mortality of officers and men in the British army may be taken on the basis of the Healthy Male Table of the Institute of Actuaries.

(2) That the mortality on foreign service in time of peace may be considered to be equal to an additional death-rate of ¾ per cent. per annum.

(Mr. M'Lauchlan, in a paper read before the Institute of Actuaries 18 months ago, assesses this extra at a higher figure, viz., 1 per cent.; but as he shows that the home mortality in the army has greatly diminished in recent years, the total premiums worked out on Messrs. Ackland and Smee's basis would appear to be quite sufficient to cover service abroad in times of peace.)

(3) That the *annual* mortality from "small wars" may be estimated at 1½ per cent. of the total force engaged on active service.

(4) That the mortality from "national wars" may be estimated at 20 per cent. of the total force engaged in the campaign.

(This is equivalent to a campaign of from 2½ to 3 years' duration on the basis of the mortality obtaining in the Franco-German and American Civil wars.)

(5) That one-half of the British army will be engaged on foreign service at any particular time.

(6) That 6 per cent. of the force on foreign service will, on the average, be engaged annually in small wars.

(7) That it may, for the purpose of computing annual military premiums payable throughout life or until retirement, be assumed that the British army and navy will be engaged once in 40 years in a national war, involving the service of two-thirds of the whole force in active military operations, for a term not exceeding three years.

We come now to the practical question of the war extras charged for the present campaign in South Africa. Most of the general public have been of opinion that the additional premium required by the Offices—usually £7 7s. per cent., for twelve months or less in the case of new, or £5 5s. for existing Policies—is too high, and in some instances charges of extortion even have been levelled against the Offices. The statistics I have given you, however, are sufficient to show that it is an extremely low charge. I hope that when the complete results of the present campaign are available they may be brought before this Institute in an easily intelligible form, and the whole question further discussed. The fuller such discussion is, the

better armed will the Resident Managers and their Assistants be to convince objectors that Life Offices are not harpies desirous of making a huge profit for themselves out of what (however necessary and however beneficial in its ultimate results) must always in itself bring heavy loss and widespread grief to a nation. When these figures are ready, special attention should be directed to the question how far they bear out the indication in the Franco-German statistics that a higher extra should be charged for infantry officers than for those of the cavalry or artillery. It appears probable that they will confirm this conclusion; but possibly clear-cut lines between cavalry and infantry work will be abolished as a result of the present war—the former becoming a kind of mounted infantry armed with long-range rifles, and trusting to these and their revolvers rather than to lance or sword, and using their horses mainly for the purpose of rapid movement. Even then, however, the troops provided with horses will probably continue to show a lower death-rate than those not so provided.

There is a method practised by most of our Offices of taking the entire war risk (not including the climate risk) of military and naval men for an annual addition throughout service—generally 10s. per cent. per annum. This is by far the best system both for the officers taking out policies and for the Insurance Companies, but for obvious reasons it can be allowed to be resorted to only in times of peace, or, if when we are at war, subject to a special provision that it is not applicable to engagement in the campaign proceeding at the time. It appears probable that the Offices will be obliged to increase the amount of this annual extra rate.

Merchant Seamen.

Mr. M'Lauchlan deals in an able manner with the Registrar-General's statistics, from which it appears:—

(1.) That the death-rate in the whole merchant service from all causes together has greatly diminished during the last twenty years, and specially during the latter part of that period.

(2.) The death-rate from wrecks, casualties, and other accidents is about 1 per cent., or 10 per 1000—the rate in the case of steamers being 7 per 1000 (or only 4 per 1000 for masters), against 17 per 1000 for sailing vessels, all ratings (or 11 per 1000 for masters).

(3.) About one-half of the total death-rate from wrecks, casualties, and other accidents is due to wrecks and casualties occurring *at sea.* The death-rate under this last head in both sailing and steam vessels increases with the size of the vessels up to 1500 tons, and thereafter diminishes rapidly to as low as 1·1 per 1000 in the case of steamers of 2500 tons or more.

(4.) The mortality from violence, accident, etc., in the home trade is only about one-half of that in the foreign trade.

It will be seen from the above that no extra premium is required for masters of *large steamers* in the home trade or for such as sail to healthy foreign ports.

Foreign Residence.

This is one of the most important branches of our subject, forming as it does a very common reason for the imposition of extra premiums. The most usual addition is that for India —generally £1 per cent.—which the most recent experience shows to be more than sufficient. The improved sanitary conditions, the more frequent changes to Europe or to the salubrious climate of the hills, and the more temperate habits of Anglo-Indians, all point to a continuance in the decline of the death-rate, and influences of this description are operating among British people in tropical climates generally, so that we may expect a gradual reduction in the extra premiums charged. In an important paper by Mr. James Meikle, F.I.A., F.F.A., on this subject, he states that the Barbadoes Life Assurance Society's premiums exceed the ordinary premiums of offices in this country by 6s. to 10s. per cent. only. The Office charges "acclimatising extras," to persons who have not resided three years in the West Indies, of £2, £1, and 10s., per cent. A permanent addition of 30s. or even £2 per cent. is commonly made by British Offices, and Mr. Meikle points out that the latter is equivalant to assuming, in the case of a man of 35 settling for life in the West Indies, that the rate of mortality is fully three times as great as that of select lives in England. In temporary assurances of short duration the addition of 100 per cent. to the mortality would require an increase of nearly 100 per cent. in the premiums, but in ordinary whole-life assurances 100 per cent. greater mortality is covered by about 50 per cent. of permanent extra premium.

Modes of Providing for Extra Risks.

The common methods of adding years to the age or a percentage on the sum assured to the premium are familiar to all of us. The assessing of "extras" under other than-whole life tables is an important matter. Take the case of an applicant who is rated up from age 20 to 24 on the recommendation of the Medical Officer. Medical Officers and Directors do not as a rule fully understand the various tables and their relation to each other, and their habit is to assess the extra or rating up as for an ordinary whole-life assurance, leaving the officials to deal with the matter of fixing its equivalent under the particular table adopted. A common plan is to take the difference between the ordinary whole-life premiums at ages 20 and 25 and add it to the endowment assurance premium at the actual age. This method is a safe one for the Office, but it bears hardly on the applicant, and now that endowment assurances form so large a proportion of our total business, I see no good reason for treating them in any respect on a less favourable basis than the ordinary whole-life policies. The equivalent mathematical addition to an endowment assurance premium would always be less than that under the ordinary whole-life table, and this is a case in which you will all see the agreement between common-sense and mathematics. The two indeed must and always do go hand in hand. If sometimes they seem to be at variance, it is because a fallacy exists somewhere in the reasoning either of the practical man or of the scientific actuary who generally is and always should be also a practical man. The future is with endowment assurances, which will at no distant date become in this country, as they are already in the Colonies, the usual form of life insurance. Probably, however, just as we apply the term "ordinary" bicycle to a machine which is rarely seen, so we shall continue to speak of a whole-life policy as an *ordinary* assurance, when the number of such on the books of our Offices forms only a small proportion of the total business. The steady improvement in longevity shows no signs of slackening, and this is a strong inducement to assurants to adopt an endowment assurance or a whole-life limited premium table in preference to the whole-life scale. And the argument that it is dearer need have hardly any weight, except for middle-aged persons, for at a young age an endowment assurance payable at an extremely old age, 70, 75, or 80, would cost little more

than a whole-life one, and would give the possessor the comfortable feeling that if he lived to extreme old age his policy, instead of being a burden to him, would be an assistance. The increase in cost is of course even less—indeed quite inappreciable—if a limited payment whole-life assurance is taken.

When a uniform extra for all entry ages is charged on the whole-life table, it is common to arrive at the extra charge for limited-payment whole-life policies by commuting the ordinary whole-life extra by the Hm. Table, but this, again, is hardly fair to the limited payment man. A table of limited premiums constructed for residence in a country for which the whole-life extra is £1 shows for the 20-payment scale a required extra of only 25s. per cent. at age 20 at entry. The required extra gradually diminishes with the age down to £1 at age 50 at entry.

Insurance officials should, I think, make more use of endowment assurances in connection with proposals on under-average lives. The usual course is, as I have said, to encourage proposals under the ordinary whole life table, and when such a proposal is declined or rated up we all know how frequently an enemy is made for the Office. I know a gentleman, well versed in life insurance matters, who, when requiring a policy, went to the Actuary of a leading Company, and explained to him that, while he believed himself to be thoroughly sound, his family history was bad, and he was therefore afraid that, if he proposed under the whole-life table, he might be rated up. He did not wish to run the risk of this, and he therefore suggested that the Actuary should arrange with the Company's principal Medical Officer to make an examination, and that they two, after obtaining all the information they considered necessary, should confer together, and state under what table they would be prepared to recommend their Board to accept a proposal without extra premium. The result was the selection of a long endowment assurance, and then, but not before, was a proposal signed. Such an arrangement might be frequently made with benefit to all concerned. Indeed, in all cases of under-average lives, except in that of a life absolutely uninsurable on any terms and for any period, a scale of alternatives might be given in something like the following manner:—

ALTERNATIVE SCALES.

		Life A.	Life B.
(1)	Whole-Life.	10 years addition.	Decline.
(2)	20 years endowment.	5 " "	10 years addition.
(3)	10 " "	3 " "	5 " "
(4)	5 " "	1 " "	3 " "
(5)	3 " "	Ordinary rate.	1 " "
(6)	2 " "		Ordinary rate.

I have purposely introduced shorter endowment terms into the test scales than would be commonly adopted, in order to show that it is only necessary to make the term very short in order to accept at the ordinary rate most of the lives that are rated up or declined. When we come to the more common ratings-up of 5 or 7 years, more acceptable alternatives could be offered.

The way of providing for extra risk, known as the Contingent Debt Plan, has been much taken exception to. The plan is, in lieu of charging extra premiums, to fix on amounts (either constant or diminishing) which shall be deducted from the sums assured in the event of claims arising before a specified date, say, for example, before the "expectation of life" has been reached. To give up the debt on the attainment of the "expectation" is, say the opponents of the system, unsound and unsafe, being equivalent to returning all the extra premiums paid in the case of all persons who survive the expectation—which would obviously, they say, lead to loss. So it would, we reply, if the usual extras only were charged, but specially increased extras can be computed which will meet the risk—just as it would be possible to pay for the ordinary risk under a whole-life insurance by specially increased premiums computed on the assumption that the whole of the premiums paid would be retnrned together with compound interest to those who attain the expectation. Popularly put, this amounts to arranging premiums on such a basis as that, out of 1000 men, the 500 shortest livers will pay not only for their own claims but also for the claims of the 500 longest livers. There would be nothing unscientific or unsafe in this, nor is there in the contingent debt plan. The debts, properly computed, are so large, however, as to astonish most people, and there is, undoubtedly, a strong temptation to reduce them to amounts which are far from being the true equivalents of the extra premiums foregone. The plan will never be largely adopted, but it has its practical uses in dealing with persons who object to paying an "extra" on the ground that they are sure to live to old age.

In my opinion, the common system of issuing policies subject in certain events to an extra to be fixed *at the discretion of the Office* is objectionable from the point of view of the public, and not altogether satisfactory from that of the Company. The practice of insuring military and naval officers at ordinary rates, subject to the imposition of unspecified extras in the event of their going to an unhealthy climate or on active service, is constantly leading to friction, and I should like to see all the Offices combining in a resolution to take such lives at the annual military and naval rates only, which should cover not merely the military but also the climatic extra risks. Failing this, the extras should be specified in the policies—say, £1 per cent. for India, £2 for any war in which less than a certain number of troops are engaged, and £10 for larger wars.

Under-Average Lives for Annuities.

This may be called the negative side of our subject. If we charge under-average lives more for insurance, should not we charge them less for annuities? Undoubtedly we should; and the only reason it has not been the practice to do so is the fear of fraudulent applicants. One or two Offices have in recent years adopted with satisfactory results the plan of granting more favourable than the ordinary annuity terms to such applicants as they were satisfied, after the strictest enquiries from the applicant's medical attendant, etc., and the most rigid examination by the Company's Medical Officers, were greatly below the average as regards prospects of longevity.

I am afraid I have taken up too much of your time, but I hope this will not interfere with our having a good discussion on the subject before us; and before sitting down I have only to acknowledge my indebtedness to Mr. Ralph Todhunter, M.A., F.I.A., the able senior lecturer of the Institute of Actuaries, as well as to the authors of the various papers I have mentioned, from which I have borrowed freely.

J. MOODY-STUART, F.I.A., F.F.A.

Insurance Institute of Yorkshire,
9th March, 1900.

LIFE AGENCY WORK.

When our worthy honorary Secretary astonished me by announcing that the Council had assigned to me the task of preparing this paper, I felt so unequal to it, for many reasons, that I begged he would have me excused. He replied in person, and my diffidence was obliged to surrender to his reason and eloquence; consequently, if this paper should be barren or inadequate you will kindly lay the blame on him; and if there is anything in it useful or worthy of consideration you may ascribe it to him also.

Now, if I was not prepossessed by the subject when I saw it first, I cannot say that my opinion of it improved upon further acquaintance; the more I examined it the more nebulous it appeared, and after about a month's consideration I found myself in a state of mental chaos. However, having reached the final depths of despair, I began slowly to ascend, and at length, emerging unhurt amidst the wreck of ideas and the crash of theories, I proceeded to consider how the subject should be treated. Should it be from the point of view of the Agent, or of the Company, or of the gentleman who acts as a buffer between the two?—call him Branch Secretary or what you will. I am sure that on the principle that "a rose by any other name would smell as sweet," he is equally grateful to the majority of agents, and his title in no way affects his capacity for emulating Oliver Twist and asking for "More!"

To the efficient consideration of any subject a knowledge of its history is essential, for it is only from our knowledge of what has happened under any given set of circumstances in the past that we can form a reliable opinion of what is likely to happen in any given set of circumstances in the future.

The great Doctor Johnson has left it upon record that knowledge is of two kinds—"We know a subject ourselves, or we know where we can find information upon it." Now, I am in the

awkward position that my personal knowledge of this subject is, I consider, one-sided, limited, and not representative of the general run of work to be done amongst agents now, and my general knowledge is chiefly derived from observation of and statements made by others. I am also unable to follow Doctor Johnson's second line, as beyond one or two more or less abortive formularies, I do not know where to look for information upon it. Had I been able to lay hands upon a history in any way bearing upon the subject-matter of this paper, it would have helped me considerably, and in the absence of it I regret that I can only superficially indicate such of the main features of the development of the "life agent" as may help us to the consideration of it.

Half a century ago I think we would be fairly safe in assuming that the number of agents on the list of any office transacting "Life Assurance" only did not exceed 100. There were no branches, no inspectors, no Board of Trade returns, no difficulty about finding investments; the agent believed his office to be the best, told his friend so, his friend believed him, "and all went merry as a marriage bell."

This happy state of things existed until about 1850, and it was not until the advent of the superintendent or inspector of agents that any real movement in the direction of agency development took place. The views of the management of the various offices as to the value of agents, previous to this, may be judged from the one fact that as a rule they would not appoint agents in the town where their head office was, as they considered themselves quite equal to securing any business to be had, and the public efficiently served as well as honoured by their presence in its midst. The result, as a matter of course, being that the best agents in the town, who would naturally have preferred to support home industry, were converted into active opponents on behalf of offices whose head offices were elsewhere.

But "a change came o'er the spirit of their dream" in the early fifties, the "Standard," then one of the most progressive offices in this particular direction, appointing as "Superintendent of Agents in England" in 1853 a former President of our Institute, the late Mr. Wm. Bentham, as recorded by his friend, Mr. Cornelius Walford, who closes his reference in these words: —"Mr. Bentham lives pleasantly in the memory of his large circle of English friends." I am induced to make this quotation, apart from the fact that it appeared to me to be a most unusual

interpolation in a work of reference, by the thought that if a new edition was now being prepared the editor could truthfully say that his memory will remain ever green in the hearts of his friends in Ireland who have had the privilege of being intimately associated with him. He was one of the pioneers of "Life Agency Work" in England, if not in Ireland, and he closed his official career as Secretary for his Company in London in 1892, having been whilst in Ireland one of our earliest Presidents. These facts seem to me to point to him as a link between the past and the present, between our Institute and our English brethren, and lead me to express a hope that many such links may be forged in the future, and that we may have the privilege of sending across the Irish Sea in the years to come as many able and well-qualified officials as it has been the privilege of the sister island to supply us with in the past.

The appointment of these superintendents or inspectors led, as might be naturally expected, to a considerable increase of work at the head offices, and some years later, when it became evident that the agents required closer supervision, and that the establishment of district offices would relieve the pressure at head office, as well as lead to further [development, the branch system made its appearance, obviously in a much less elaborate form than we have it at present. Then it consisted of a Secretary—resident in actual fact as well as in name, who might possibly have the assistance of a clerk or two—whose work was largely governed by his own natural temperament, and in general consisted of stirring up the agents by letter and making an occasional state procession amongst them when the weather was fine and business at headquarters not particularly brisk.

Now, the Secretary, although still described as resident, is ubiquitous, and would better deserve the title of "Itinerant," seeing that he appears to possess the enviable qualities of that peculiar ornithological specimen discovered early in the present century by that eminent Irish orator, Sir Boyle Roche. He has the assistance of one, two, or more inspectors equally eloquent, ubiquitous, and itinerant, who fly to and fro and up and down in the earth, compassing sea and land if necessary in the effort to make even one small proselyte. Recently some of the most progressive offices have further developed the principle which led to the establishment of branch offices, and as the Resident Secretary appeared above the horizon as soon as the necessity for

the development of the agency system became apparent, so now that bright particular star, the Agency Manager, has arisen in these latter days of competition to be guide, counsellor, and friend of the Branch Secretary.

Now, as the Branch Secretary was the outcome of the necessities of his time, and has, I think, justified his having been called into being, so it will be found in the future that the Agency Manager, without "a probable possible shadow of doubt," is a necessity to those offices having a large number of branches and competing for large annual returns of new business.

In the old days, when competition was the exception rather than the rule, and the Resident Secretary was indeed resident, it was a simple matter for the Manager or Secretary of an office to keep in touch with, and personally control and regulate, the few and simple wants of the official outposts; but in these latter days, with branch offices everywhere and any number of out-of-doors officials attached to each, with competition—such as might almost be described in the words of the Litany as "battle, murder, and sudden death"—the order of the day, it is a practical impossibility for the two chief officials of any office, whose minds are of necessity engrossed with larger, broader, and more important considerations, to afford that personal, sympathetic, active, and practical attention to details which is essential to the well-being of the branches and to their highest development as new business-producing factors.

Here, then, we have the machine for Life Agency work as it exists in this year of grace 1900 expressed by three factors—(1) the Agency Manager, (2) the Branch Secretary, and (3) the Inspector or Canvasser, and its output is annually reported to the Board of Trade under the heading of New Premiums. It has been evolved by time and necessity, thought and money, and its own value and the value of its work to the nation, socially and economically, will never, I am afraid, be justly estimated or fairly admitted by the public, so that we must remain content to "do good by stealth and blush to find it fame," when some benighted individual feels himself forced to admit that we are not such parasitic nuisances as we are so generally considered to be.

Now, before going further with the subject, some of you may possibly think that I should indicate—chiefly for the benefit of the rising generation of our members, many of whom, I have no doubt, are already ambitious of fulfilling in due course the duties

of all three positions—some of the essential qualifications necessary to success, and as they must first be inspectors before gaining the other two more responsible positions, I will make the last first.

The primary qualifications of an Inspector are a sound constitution and a good general education; for with him it is an absolute essential that he should have a sound mind in a sound body. We know upon the authority of Messrs. Gilbert and Sullivan that "a policeman's life is not a happy one," and neither is that of an Inspector of Agents a particularly easy one. For, if he has no coster of matricidal proclivities to deal with, he has to meet men who take an equally fiendish delight in upsetting his contentions and jumping upon his authorities; and when not occupied in this particular employment he is either sleeping in possibly damp beds, travelling in draughty railway carriages, feeding at uncertain hours on perhaps doubtful viands, or otherwise running much risk of physical damage.

If he possess these two primary qualifications he should add to them a thorough knowledge of official routine, and, whilst acquiring this, should endeavour to enlarge his ideas of men and things and to make himself up thoroughly on the theory and practice of Life Assurance, so as to be able to expound it to the possible proposer. Above all, he must cultivate that peculiar quality known as "tact"—the power to say and do the right thing at the right moment, neither more nor less: for his learning may exceed that of the ancient Egyptians, his eloquence that of Demosthenes, and his power of endurance that of the North American Indian; yet, if he has not this necessary qualification, he will often find his best efforts fruitless. Many men are unassured to-day because they have been approached at the wrong time and in the wrong way.

Finally, I would recommend to their consideration the advice of Polonius to his son on the question of physical and mental apparel. As to the first, he says—

> "Costly thy habit as thy purse can buy,
> But not expressed in fancy; rich, not gaudy,
> For the apparel oft proclaims the man."

And if we read this in the light of a remark made by a celebrated Frenchman, "that we receive a man according to his appearance, but take leave of him according to his merit," we shall see the

advisability of suiting our outward man to the circumstances in which we may be placed. You can imagine the effect upon the ordinary mind of the spectacle of an otherwise immaculate and sensible gentleman plunging about the muddy streets of a small country town on a wet market day, attired in a silk-faced frock coat, tall hat, and patent leather shoes.

He deals with the second point thus—

> "This, above all—to thine own self be true;
> And it must follow, as the night the day,
> Thou canst not then be false to any man."

The Inspector will find it of incalculable benefit to be fully convinced of the righteousness of his mission, as, apart from its moral effect upon himself, he will often find that honesty of purpose and personal conviction of the benefits he advocates will secure a proposal when mere knowledge and perfunctory argument will depart empty, for the average man—whether he be our agent or his friend—is quick to detect any insincerity of thought or utterance.

Exit the Inspectors, who all hope some day to re-enter upon the scene as Branch Managers or Resident Secretaries. I think we may consider the terms synonymous. I am afraid, however, that many are doomed to disappointment, if only from the fact that there are not appointments enough to go round, and that those who hold them are of very tenacious habit. But apart from this, as in all walks of life, there are many men who, under guidance and control, can produce almost phenomenal results, yet, when left to their own initiative, find themselves soon at the end of their resources; so there is bound to be a certain proportion of Inspectors who can never hope to succeed as Branch Managers; just as there are, I doubt not, many managers, and some of them of the best, who, if sent to work actively amongst agents under modern conditions, would be huge failures.

It is not an absolute essential to success as a Branch Manager to have been a particularly brilliant Inspector; but if the Branch Manager has had a successful career in the more junior office, he will be all the better able to guide and inspire his own assistants. The Inspector's view of matters is more or less "cabin'd, cribb'd, confin'd" to the work of securing the largest possible business from the agents he is working with or for, and he bristles up at once at the word "proposal" as a terrier does at the word "rats."

The Branch Manager, on the other hand, has to think in a wider field, to consider questions of policy and to lay out plans of campaign, to conserve business as well as to secure it. He has to administer his district on regulation lines, to see that the affairs of his Company therein are carried on in accordance with its position, capabilities, and traditions, and to translate the theories, ambitions, and aspirations of the directorate in the matter of new business, sometimes perhaps not very clearly defined, into tangible and practical reality. His duties are chiefly administrative, and will, I think, become more and more so as time goes on, for, as I have already said, the Agency Manager has arrived. To him will be entrusted the visions of the Directors in regard to new business, and they will look to him to give them practical effect. To him will fall the duty of formulating the general plan of campaign, and of providing the means to carry it to a successful issue. He will, or should, be able to assimilate and correct the views of the strongest of his local representatives and use them to assist any who may be weak. His advent seems to point to greater homogeneity in the agency work of the office and to a more general uniformity of practice, which will increase the demand on the administrative rather than the initiative ability of the Branch Manager. It seems to me that it is essential that he should have a wide experience of branch and agency work, and, as well, the knowledge, ability, force of character, and largeness of mind necessary to inspire the branch official with a fervent loyalty. He should be one to whom the branch official can go at any time with the certainty of receiving sympathy, guidance, and help.

Now to "return to our wethers," to quote Francis Rabelais, this machine—the nature of which I have endeavoured to indicate—might be described as one specially designed for the cultivation of a plant known to Insurance botanists as the "Life Agent." There are three principal varieties of this plant—although there are many others which, apparently distinct varieties in themselves, are in reality only crosses of these three —of which it might be said, as of the three sons of Noah, "of them was the whole earth overspread."

The first of these is the original type. To obtain it is an object of ambition to most Insurance gardeners, and, being obtained, an object of pride. It is a fine, large, upstanding plant, with plenty of foliage; it does not exhaust the ground,

and although its fruits are not numerous, yet they are generally large and juicy, and obtained at a trifling cost. It is daily becoming rarer, and doubtless in due time will become a hothouse variety.

The development of public taste, just as in the matter of tomatoes and bananas, in recent years compelled gardeners who cultivate for profit rather than for show purposes to evolve a more regular fruiting and hardier variety, and in due course number two made its appearance. Its fruit is not as large, nor is the plant itself as pleasing to the eye, as number one. It requires more constant attention, but it may be relied upon, in judicious hands, to furnish a regular and paying annual crop. Should, however, the gardener, under pressure of circumstances, force it to exceed its normal productiveness, he will find it necessary to nurse it carefully for a year or two before he can rely on it to produce as regularly and as healthily as before he did so; and should he continue this forced production he will soon find that the profit obtained from the deteriorated fruit does not compensate for the additional labour and cost of artificial fertilisation.

It is this pressure of circumstances, the necessity or fancied necessity of producing annually a fixed or increasing quantity of fruit, that has led to the evolution of variety number three. It cannot be successfully cultivated in the same bed as the other two, as it exhausts the soil and affects them injuriously in other ways. It might possibly pay to cultivate in a border by itself. It is a mean and hungry-looking plant, has no foliage, shoots up quickly, produces but one fruit, and then dies. These, as I said before, are the principal varieties, but there are many intermediates whose productiveness and profitableness depend upon specially peculiar qualities of soil and the skill and experience of their cultivators.

This brings me to a point which it seems to me will very soon require the careful and special attention of those offices who mean to retain the local, as distinguished from the canvassing or itinerant, agent as a policy-producing factor in their scheme of existence. Up to date all our efforts would appear to be directed towards stimulation—may I say over-stimulation?—with a view to excessive production, and this has, without a doubt, already considerably weakened the agents' personal power of controlling business, and must, if persisted in, inevitably result in completely sterilising him. When the process is complete, of what use will he be to the office?

Sometimes I am tempted to think that he is being rapidly degraded into the position of the canine quadruped described by the "Yankee" sportsman who wrote his experiences of sport in England, as a poker-tailed smell dog; his only duty being to use the telegraph wire for the same purpose that the dog uses his tail —namely, to signify to the sportsman (call him inspector if you like) attached to him that there is "game afoot." Mr. Sportsman arrives by the next train, and, having loaded his "double-barrelled shot-scatterer" with cartridges of facts and fancies, goes for the "game," and having bagged it he returns home with the happy feeling of the Village Blacksmith of having "something attempted, something done, to earn the night's repose." The reverse of the medal is seen, however, two days later, when he receives the papers from the doctor and a letter from the agent to say that, on further consideration, Mr. Hollingsworth MacStaggers (the proposer) has decided to delay the completion of the transaction until next year.

Now, all this disappointment to the official, and useless expense to the office, might have been saved had the agent been taught how to work his cases for himself, and only to call for assistance when such was absolutely required by reason of his own want of technical knowledge or inability to reconcile to his friend's satisfaction the relative pretensions of his own and some other office.

In the one case the policy would have been obtained at less cost and probably prove permanent, and the assurant would have felt that he was doing it of his own free-will, be pleased with his friend the agent, and become a source of future strength to him and his Company. Whilst in the other, even if the proposal is completed and a policy issued, there remains at the back of his mind a feeling that he has been forced to a decision out of his time, and a sense of doubt as to the wisdom of that decision which does not help him to recommend his friends to "go and do likewise"; and where, as in the case of Mr. Hollingsworth MacStaggers above-mentioned, his mature consideration results in a postponement, it means that he considers that an attempt has been made to exploit him in the interests of the agent and the Company, who suffer in reputation accordingly, and, as the fish once hooked and lost is slow again to rise, so he becomes sceptical about the benefits of Life Assurance, and will very probably never again be tempted to approach the subject, no matter how skilfully the bait may be designed and applied.

This is, of course, merely a passing illustration of what I have no doubt frequently occurs under our present system, and it is hard to know how matters in this direction are to be improved; but I think it points towards the necessity, in the near future, of substituting for our present somewhat crude and empiric methods of work something more definite and scientific, unless we are prepared to obliterate the local agent altogether and depend for our new business upon some system of itinerant canvassers. In many cases the offices are paying two men for the work of one, and this may possibly account in some measure for the increase in the expense of obtaining new business. Why the office should pay an agent commission upon proposals obtained by their paid inspector, in which the agent is impotent for good or evil; and why it should pay an official for doing the work of an agent willing and able to work for himself, are two little inconsistencies which, to quote Lord Dundreary, "no feller can understand!"

One of the humoristic writers of the earlier part of the nineteenth century says—

> "Necessity's the mother of invention,
> A proverb I've heard many mention,"

and doubtless the exigencies of the time to come will evolve the system necessary to cope with its own difficulties; but I think I may say this much, that it will require to be based upon wider and better principles than those which dictate our present methods.

It may be that the solution will lie in the elevation of the official, and I am quite satisfied of one thing, that if the offices were to insist upon a higher degree of technical knowledge in those to whom they intrust the development and control of their agencies, they would find these much less expensive and not less fruitful. Day by day greater and greater attention is being paid in every profession and trade to technical education, and we do not require to be very far-sighted to perceive that the qualifications which sufficed past generations of inspectors to commence work upon will not be sufficient in the future, for the simple reason that the average man in the street now thinks he knows quite as much about Life Assurance and the relative merits and ability of the various offices as any official, and a proportion *do* know quite as much as the average inspector of not very long ago. "Knowledge is power"—another proverb—and if the official is to maintain his power of conviction and his ability to guide

and assist agents, his knowledge of his subject must always be considerably greater than that of the general public. If it is necessary for a doctor to go through an exhaustive course of study of the human frame and of the various branches of science bearing upon its well-being before he gets his "licence to kill"; if it is necessary for a tradesman to serve an apprenticeship of a fixed number of years before he becomes entitled to the wages of a journeyman; if it is necessary for a barrister to eat his way to the bar, and if it is necessary that you should know how to ride and shoot before you will be accepted for service in the Imperial Yeomanry, surely it is not too much to expect that gentlemen who are to be entrusted with the delicate task of assisting, guiding, and educating in the principles and practice of our business a large body of men of various social grades, habits of thought, and ideas of life, should be called upon to show some evidence of at least a theoretical knowledge of the duties of the position beyond that obtainable by sitting on an office stool from 10 to 4 daily.

In the early days the offices were of necessity compelled to take their superintendents of agents largely upon trust, but they seem, on the whole, to have exercised a wise choice in appointing men who had arrived at years of discretion and with a fair knowledge of men and things, who could be depended upon not to spoil the horn if they did not succeed in making the spoon. Even if they did make mistakes now and then—*humanum est errare*—the agent of those days was a hardy plant who could stand a certain amount of rough handling without being seriously injured, and, as in those days there maintained some idea of nourishing as well as milking him, his resuscitation was usually rapid and complete.

Now, whether it is that the choice of the offices is that of the proverbial "Hobson," or that the present unseemly scramble for business has rendered them unmindful of the necessity of providing for production in the future as well as harvesting in the present, anybody seems good enough to entrust with the appointment and care of agents, and technical knowledge is often represented by young gentlemen whose precocity of intellect has led them to despise the old-fashioned method of ascent through the usual office grades. Knowledge and the zeal which is usually an attribute of youth together are very effective, but it is not always that a grey head is found on green shoulders. No doubt in due time, having acquired experience, a certain proportion of the men

so appointed become very valuable officials; but in the acquirement of that experience, how many agents have been damaged or utterly demoralised?

This is my plea for the higher education of the official intended for Life Agency work, in the interest of the offices, the agent, the public, and the official himself, for to the want of this preliminary education I think is due much competition which might be avoided, and, if I may say it, many pernicious and unreliable comparisons. Honest competition, however keen, is good for the offices and for the public, but when "get business honestly if you can, but get business," becomes the motto of the day, the agent is destroyed, the public demoralised, and the character of the officials engaged inevitably deteriorated. We reap but what we sow, and "Nemesis" walks slowly, but never tires.

Already, if we pause and listen, her heavy footsteps may be heard upon the road behind us. How long will it be until she lays her gruesome fingers on our shoulders and cries "Halt!"

Now, if it be true that we reap but what we sow, it follows that we must sow in order to reap, and yet it seems to me, paradoxical as it may appear, that the offices have until recently been reaping a harvest which, to a very large extent, they have not sown; and that therefore those offices which have had their agents on the stretch for some years with a view to a large business, without at the same time endeavouring to lay a foundation for future growth—which have been content to increase the number of their inspectors to do the work of the agents rather than to improve the agent and develop their agency system—are likely sooner or later to become inconveniently acquainted with the retributive Fate I have already mentioned. Shakespeare says:

> "There is a history in all men's lives
> Figuring the nature of the times deceased,
> The which observed, a man may prophesy,
> With a near aim, of the main chance of things
> As yet not come to life."

If we consider the history of Life Assurance we will see that in its early stages it was simply treated as a gambling transaction by the great British public, who became so partial to it as to compel the Government of the year 1774 to pass the Act of Geo. III., cap. XLVIII., and it was not until the great tide of the industrial development of the 19th century began to flow that Life

Assurance really began to move. This seems to be borne out by the fact that in 1803 there were only nine Life Offices in existence —7 English, 2 Irish, and none Scottish—whilst between that date and 1854—when Insurance Company promotion reached high-water mark, no fewer than 26 offices being established in that year—284 were established. It may be of interest here to note that of these nine offices but four survive as more or less active forces to-day. I give them in the order of age—the Royal Exchange, the London Assurance Corporation, the Equitable, and the Pelican. Of the others, the Amicable—eldest of the tribe—is, I believe, being carefully tended in its old age by the Norwich Union; the Westminster was swallowed by the Guardian in 1863; and the "Globe" now rounds off the title of the office of to-day known as the "Liverpool and London and Globe."

The two Irish offices have also disappeared. The "Commercial of Dublin" was absorbed by the then five-year-old "Guardian" in 1826; but what became of the "Royal Exchange of Ireland," which disappeared in 1821, I have been unable to trace.*

Now, if we consider that between 1706 and 1803 there were only nine offices established, and that their ideas of Life Assurance were of necessity more or less crude and undeveloped, and their policies hedged around with many restrictions, we shall see that we can hardly attribute this great development to anything of intrinsic merit in the subject itself or any specially attractive educational process initiated by these offices. To what, then, was it due?

If we remember that it was the existence of innumerable private hoards of small savings amongst the peasantry of France, which they were induced to exchange for Government scrip, that enabled the French to pay off with such wonderful celerity their heavy war indemnity to Germany—that it is the increase of small savings in this country which is largely responsible for the development of limited liability company promotion with which we have

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*Since reading this paper my friend Mr. William Coote, manager for Ireland of the "Sun" offices, advises me that the "Royal Exchange of Ireland" was taken over by the "National of Ireland," and that in 1803 there were in existence Irish offices other than those mentioned which, although principally engaged in "Marine" and "Fire" business, also professed to underwrite "Life" risks—viz., Dublin Insurance Company, established 1750; Hibernian, established 1771; Sun Insurance Company of Dublin, established 1802. The fate of the first-mentioned is unknown, and the last died in 1804. The "Hibernian" sold its "Life" business to the "National of Ireland" and its "Fire" business to the "Sun" in 1838.

become familiar in recent years; and that a considerable proportion of the policies issued, even now, by the offices are held by banks, manufacturers, wholesale traders, and others as security—we may with reason attribute this great development to something outside Life Assurance as then understood: to some national need—namely, to the necessity for this particular form of protection in trade finance. The demand for any given article will always increase the supply and number of those engaged in its production and delivery, and *vice versa.*

At the beginning of 1856 there were 193 offices in existence, at its close only 180; and since then the process of elimination has been going on, until now we have about half that number of native offices reporting to the Board of Trade. Doubtless, many more will be eliminated by amalgamation or absorption within the next quarter of a century. This may to a certain extent be due to the stress of competition, but I think that, if the national demand for legitimate Life Assurance had increased—as all things, increase of population, wealth, and trade considered, it should have increased—in any way proportionately to the desire of the offices to supply it, such a continual reduction in the number of offices would not have taken place.

If, then, we assume that the great development of Life Assurance in the 19th century—at least at home—was largely due to certain necessities of trade finance caused by a rapid development of the industrial resources of the country, we must look to something in trade finance to account for the non-increase in the demand for it, and I think it will be found in certain altered conditions under which trade is now carried on.

At the beginning, this industrial movement—and, of course, there are still survivals—might be described as a "one-man" movement. John Smith owned the mill, the factory, the warehouse, the patent, or the mine. It was John who perceived the opportunity and conceived the scheme by which he might develop his property to advantage, and it was John's business ability and capital which enabled him to carry it out successfully. His was the risk, his was the profit. Or it might be that Tom Brown, Dick Jones, and Harry Robinson had formed themselves into a company and sought John Smith out, and that the scheme for development was theirs—they each contributed to the capital and divided the work, profits, and liability, which latter was not then limited.

In either case, when additional capital was required for further development, it was obtained by submitting the accounts of the concern to a banker or other capitalist, who might be induced to make the necessary advance; and not by, as in these days—if you have already "limited your liability"—going to your stockbroker and getting him to underwrite a certain sum in debentures and trade them off to his clients; or, if you are not already "limited," floating yourself at a figure which enables you to offer a confiding public preference shares for the amount of the loan, whilst the ordinary shares representing the full value of the concern are retained by the vendors as testimony of their confidence in the value of the security.

Should the banker or other lender applied to consent to make an advance, he had to consider the effect upon his security of the death of the man whose body contained the brains and ability upon which the success of the venture depended. Obviously Life Assurance alone could discount this risk, and it in this way became a necessity to trade finance in the earlier part of the century, as it is no longer. The individual has now been eliminated, and a corporation, without soul to be saved or body to be assured, substituted. The old firms have mostly been turned into limited liability companies, and for new ventures new companies are formed. The collective brain and ability of a Board of Directors is responsible for the business, and if new capital is required it is secured by the issue of debentures—a sort of mortgage by subscription.

The gradual decline in the proportion of whole-term assurance to the total assurances now being written by the offices seems to me to confirm this view, and the development of endowment, double endowment, discounted bonus, and other "fancy" schemes of assurance to point to the fact that the offices are finding it necessary to seek business on other grounds and from different sources to those on which they formerly relied. This in itself will call for greater care in the appointment and education of agents, and for a higher technical qualification in the Inspector than has hitherto sufficed.

This, however, is not the only way in which the Limited Liability Companies' Acts have increased the difficulty in getting business. Before their advent men of limited means who could save £10 to £50 per annum had not so many opportunities of investing in industrial enterprises, and were compelled to accumu-

late their savings by depositing them either in a bank or a stocking until they attained sufficient dimensions for the purchase of Government stock or house or lands, or to lend on mortgage. If they ventured into a trading company they ran the risk, in event of its proving either a fraud or a failure, or both, of not only losing their savings so invested, but their little all as well, and it was not difficult for an agent to show the greater benefit and security to be had from a Life Assurance Company, especially to married men.

Now, the fully paid-up one pound share without further liability enables the man with a spare "fiver" to secure five shares in some newly-floated industrial company, which may return him an annual income of anything up to 100 per cent.—as I believe was recently the case with the lucky holders of original shares in a Dublin venture—and the uncertainty as to the dividend gives a zest to the proceeding, whilst the risk is reduced to the bare possibility of losing the stake. In these circumstances, it is becoming daily harder for agent and official alike to convince the budding capitalist—especially if he has not undertaken the responsibility of matrimony and "given hostages to fortune"—of the solid financial benefits of Life Assurance.

In passing, I may remark that a source from which business was often obtained has, also by result of modern legislation, been dried up—at least in Ireland. The lease for lives has disappeared, so far as the holding of agricultural land is concerned, and no longer do we secure policies payable upon the last death of Her Majesty the Queen, the Duke of Cambridge, and the eldest son of the lessee, who was generally the holder of the lease when the transaction was suggested to him, and who not infrequently elected to carry the Assurance on his own life solely. Loans on life estate in Ireland, which were once a fruitful source of business, are now, I believe, not very numerous.

In the world's history we find that nations come and nations go, but that the principles of the life of the nation, if right, invariably survive, just as the soul survives the body; and that whenever an instrument is required to carry out any portion of the illimitable and unfathomable design of the great Architect, that instrument is called into being, and, its work done, it disappears. Our nation, trade, and social arrangements existed before Life Assurance made its appearance, and it is possible to conceive a position of affairs in which Life Assurance may be no longer

necessary—although its principle will doubtless survive in other forms—and the Agent and Branch Official be as extinct as the Dodo.

For a century previous to the national demand for it, Life Assurance was growing and groping its way in the dark, and only emerged from its chrysalitic condition when required as a handmaid to trade, but now trade as at present carried on is gradually feeling less and less need of its services, and its hope of a further existence of usefulness depends upon the social requirements of the time. Here again, however, legislation threatens it, and the growing tendency to grandmotherliness, or perhaps some would call it Socialism in modern legislative ideas, may be found a hindrance to development on this side.

Any system of State-aided pensions, although originated for the benefit of the agricultural labourer, will doubtless in due time—the principle once admitted—be extended to other wage earners, even to those who call their wages "salary," and as it is to this class of the community that Endowment Assurance specially appeals, we may fairly anticipate a reduction in the demand for this particular form of combined investment and protection.

It is also possible—and "'tis a consummation devoutly to be wish'd"—that the great trades unions may elect to beat "their swords into plough-shares and their spears into pruning-hooks"; and, instead of frittering away their hardly-earned and subscribed funds upon periodical and compulsory holidays—undertaken, as a rule, by the vote of their more junior and irresponsible members—they will become, as I think they were originally intended to be, mutual benefit societies, affording their members protection in sickness and help in time of need; supporting the widows and orphans of the members until such time as the latter reach an earning age, and giving such of them as are of the male persuasion their father's trade. Thus, the advisibility of providing for his own old age or for his widow and orphans by the aid of the Life Offices will no longer be so apparent or easily demonstrated to the wage earner, and may seriously affect the future returns of those offices which carry the flag of "Industry."

These are two of the rocks ahead, one of which may also affect offices doing "ordinary" business, but there are others. The increasing wealth of the nation, which renders it possible in these days to secure capital for anything, even a patent to "extract sunbeams from cucumbers," has already reduced the rate of

interest on first-class securities, and we may fairly anticipate "an increase of diminution" as the years go by. Should the average rate of interest fall to anything like $2\frac{1}{2}$ per cent. on securities such as are suitable for Life Office investments—and it does not seem so far off—it would be an impossibility for the offices to offer Endowment Assurance at rates and with advantages which would enable us to compare it favourably to the satisfaction of the public with investment in good and reliable industrial securities, and a further declension might render it impossible for the offices to transact any class of Life Assurance at rates which would make it in any way useful to the body politic. Now, if law-givers and financiers oppose our advance, our scientific friends threaten our retreat, for I read in a scientific notice in my old friend, *Chambers's Journal*, that a French professor with a Russian name—I do not venture to pronounce it—has made certain investigations which lead him to hope that human life may be prolonged to an extent never before anticipated except by Methuselah, and that two other learned doctors have discovered a prophylactic against that craving for alcoholic stimulants which is such a prolific source of those mental, moral, and physical diseases which cause premature death. Thus, it appears possible that we may arise some morning, not, like Lord Byron, to "find ourselves famous," but, like Othello, with our "occupation gone," and our little barque, having weathered the dangers of the financial Scylla, engulfed in a Charybdis of physical immortality.

Now, having given utterance to these somewhat Cassandra-like ideas, I would like to say that they do not proceed from any doubt as to the past, present, and immediate future usefulness of our business; nor from inappreciation of the immense volume of business now being secured annually as compared with the figures of some years ago; or of the fact of the increased adoption by the nation of an underlying principle of Life Assurance, viz, co-operation for individual benefits unattainable by individual effort; but from the fact that I think there are certain ripples ahead of us in the placid ocean of our present existence indicating hidden dangers towards which we are gaily sailing with the wind abeam, and from which it behoves us to "bear up" as soon as possible, or even, if necessary, "go about," that we may not find ourselves high and dry upon a lee shore.

We appear to be in a somewhat transition state as to our agencies, and therefore that our work and methods of work may

have to be modified in the future. For the "old order changeth," and under the new we shall have new conditions to deal with, although human nature must always be the same, and our chances of success will depend upon our ability to reduce our principles and practice to the comprehension of our generation, which is naturally short-sighted.

Now, I am sure many of you wish that I would descend from my "iambics," or, in other words, give effect to a remark made by one of my professional brethren—"Oh, just tell us how to get business." That is just what I am unable to do, for many reasons. Principally, because there are so many of our members who know far more of the practical difficulties of the work than I do, and to such an audience it would not be seemly that I should speak dogmatically; although I may say that Life Agency work cannot be reduced to a formula, and that although we may keep annotated lists of names carefully, and observe to the letter of the law advisable regulations as to periodic visitation, all known already to the veriest tyro at the work, yet our methods of securing business must vary according to circumstances—according to times and seasons, persons and opportunities.

A glance at the list of agents at any office will, I think, show that it largely resembles that portion of the collection of the famous naturalist, Mr. Venus, which he denominated "Human Warious," and it is for this reason that it is a practical impossibility to elaborate any set system of work with agents. You cannot expect a banker, solicitor, land agent, or other professional gentleman of possibly large means and well-defined social position to conduct his agency in the same way as one who makes it a chief portion of his daily business, or who occupies a less conspicuous position in life. To speak of cases of four and five figures to the latter, or to suggest the advisability of securing £100 cases to the former, would be about as wise as to employ an Atlantic liner to plant potatoes, or to set a County Kerry peasant to plough the ocean with a spade.

The big agents are the artillery of our army, and those of lesser weight our small-arm department; and he is the ablest commander who obtains the best from both. If I cannot afford any affirmative help, I may perhaps be able to do so negatively. If I cannot tell you what to do, there are one or two things I can tell you not to do. I can emulate Mr. Punch, and say "Don't." Don't appoint an agent you can't trust, for as his character is, so

will the business he sends you be. Don't appoint a man who is prepared to give up another office for the sake of a small increase in the rate of commission, for as he is prepared to sell his friends to the highest bidder, so is he prepared to sell his office to his friend for the sake of the commission. Having appointed an agent, don't expect impossibilities from him. Don't rush him; let him find his feet. Don't expect him to master at one sitting, or one visit, all the intricacies of practice of your office, or of the general principles and practice of Life Assurance which have occupied your attention exclusively for years. Guide, educate, and train him. It may take some time to do, but once the process is complete he will prove a source of strength and find business for you when you are far away or asleep.

It is too much the tendency of the time to take all the work of securing business into our own hands, and to treat the agent as a mere figurehead. It weakens his ability to secure business by destroying his local prestige. There are two other great sources of weakness to the agency system, and they are the one-policy agent and the granting of commission to an assurant upon assurance of his own life; they are sometimes, but not always, the same thing. Be loyal to your agent and he will be loyal to you. Many times it has been said to me in various parts of Ireland, "I am an agent for such-"and-such an office, but I don't bother about looking for business, "as they have appointed so many agents in the town; some of "them I secured for them myself, but they got appointed for the "sake of the commission"; and, again, "I thought I had so-and-"so secured, but he went to the —— office because they gave him the "commission." I once came across a very glaring instance of the effect of such action, where a very active and able agent for a well-known office told me he would not send his office any more business because they had granted a client, on whom he had been at work for some time, the commission on his own policy.

I would not have referred to this matter at all had it been the habit of only one office, as I should have assumed that it was their regular practice, and that they knew their own business best; but it appears to be a growing evil, and to be countenanced by even some of the best offices, and the public are becoming so habituated to it as almost invariably to expect this allowance. Granting direct commission may swell the total of business on occasion, and the appointment of a number of useless one-

policy agents may swell the muster roll and lend it an appearance of strength; the continuance of the practice spells "death" to the useful local agent, and can only lead to an entire re-modelling of the system upon which the offices have hitherto depended for business. I am personally satisfied that the practice of allowing direct commission and commission to one-policy agents who only hold their agency to qualify them to draw commission on their own assurances, is indefensible, dishonourable to the offices which countenance it, and dishonest to the general body of their policy-holders, unless the policy-holders to whom this special allowance is made are placed in a class by themselves and only allowed to participate in the surplus created by their own artificially-attenuated premiums.

Here it may be interesting to transcribe the views of Mr. Francis Bailey, who, writing in 1810, thus expresses himself on the subject of Agency Commissions:—

"Many of the public companies who do not make any return "of the profits to the assured allow a *liberal premium*—generally "5 per cent. on the payment made—to any person who will pro-"cure an insurance to be effected at their office; and this commis-"sion is also allowed to any person who makes the *annual* "payment, *provided it be not the party himself!*—an artifice which "is easily seen through, but which opens such a door to fraud and "imposition that it cannot be too severely reprobated. And, "however much it may be sanctioned by the directors in their "*public* capacity, we are all aware what their emotions would be "if they discovered any of their tradesmen tampering with *their* "*own* servants in this opprobrious manner, since they must well "know who would eventually pay for it. I omit to give the "names of those companies who have adopted this nefarious "practice, under the hope that such a mean and improper artifice "will not be encouraged in future." I wonder what Mr. Bailey, if he could "revisit the glimpses of the moon," would say of Agency Commission in these days.

Now, before concluding, there is one more "don't" in my budget, and, as it applies to head offices in general, I venture to say it with fear and trembling born of a respect for those mysterious places inculcated in early life; but I feel compelled to say it, as any action of the head offices—although in their self-effacing modesty they may not think so—has a far-reaching effect for good or evil upon our work amongst agents. Before doing so, however,

I would like to remind you of what I said at the beginning of this paper, viz.:—That my general knowledge is chiefly derived from observation of, and statements made by, others; to which I would now add the words of Hamlet—"We, that have free souls, it touches us not." I have somewhere read of a music-hall in one of the towns of Western America where this notice is conspicuously displayed—"Don't shoot the man at the piano; he is doing his best"; and we might translate this into, "Don't worry your branch manager." If business isn't coming in it worries him quite enough and affects his pocket also if he is in any way remunerated by commission. Don't tie him up with red tape and expect him to lick creation. Don't send your champion into the ring in fetters, and, just when his opponent is about to administer his famous knock-out blow, encourage him by kicking him behind.

The late Mr. Walter Browne, in his address to the Manchester Institute in 1877, referred to this latter little peculiarity on the part of head offices, and, if my information is correct, some of them have not improved much since then; and there are some so enamoured of forms of check and detail as to be capable of elaborating a system which would require the general manager to remain in after office hours to check the petty cash. Of what practical usefulness is a weekly list of the names of erratic Irishmen from whom business may or may not be obtained, or your private opinion that Tim Doolan or Paddy Flanagan will probably assure for £100 or £200 before the year is out? Or how can it affect the total of new business or the general administration of the district for the head office to receive an elaborate form showing that the branch manager left Cork for Limerick, or Dublin for Galway, at 8·45 a.m. on any particular day of the week? Petty details of this sort are void of practical utility and only serve to irritate the branch official, in whose mind they may engender a feeling that he is not trusted, which, if once allowed to take root, must cause him to lose heart and render his work amongst his agents cramped and inefficient.

Can you imagine anything more disheartening than when you get home late at night after a hard day's work, which may have included considerable exposure to the elements, "weary, worn, and sad," with a general sense of failure about you, to be compelled to sit down and fill up an elaborate form showing how many hours, minutes, and seconds you spent vainly endeavouring to convince Tom Snooks that he did not know his own business, or

converting Mrs. Moriarty to the wisdom of allowing her goodman to assure for £100 in her favour; which return you know perfectly well will in all probability be duly pigeon-holed by a junior clerk in a back office at head-quarters who knows nothing of, and cares nothing for, the wearing thought, unwearying vigilance, and ceaseless action which is the lot of the Branch Manager in these days of excessive competition?

What the head offices do want, apart from necessary financial returns, are what Mr. Mantalini would call the "demnition totals"; and they will be wise, as far as possible, to limit such returns as are necessary to these. I said before, "Don't appoint an agent you can't trust," and the remark applies with even greater force to the chief official in charge of a branch. To quote Mr. Browne again:—

"It is true of human nature generally that you will get very "little out of it by hounding, snubbing, and distrusting it; but "you will get a great deal out of it by kind and generous treat-"ment. A district secretary is like other people. Put him on "his honour by making him feel that you trust him, and you thus "increase your ground for trust. This is the wise course, but not "the invariable one."

And now, gentlemen, I have done. I trust I have not appeared wearisome. I have chosen rather to deal with general matters which may affect the future of our work with agents than to inflict upon you a repetition of the petty and often somewhat unpleasant details which go to make up our daily life as those who have experience in the work know it.

I am afraid, to quote a late eminent member of Parliament, that I have been somewhat carried away by "the exuberance of my own verbosity"; but, although my theories may be heterodox, and my ideas visionary, I can assure you that I have endeavoured to follow the instructions of Othello—

"Nothing extenuate
Nor set down aught in malice"—

and if I have pointed out flaws within our present system, or problems likely to be set "the powers that be" in the near future, I must leave their respective rectification or solution to others better qualified for the task.

W. M. POTTERTON.

Insurance Institute of Ireland,
2nd March, 1900.

EMPLOYERS' LIABILITY AND THE WORKMEN'S COMPENSATION ACT, 1897.

CIVILISED communities are slowly but surely recognising that the various industries should bear the cost of all the accidents which happen to employees while in the discharge of their duty. The principle has been proved to be just and reasonable, and would undoubtedly be more readily accepted were it not for the difficulty of equitably assessing the various charges.

As a political and social problem it has occupied, and is occupying, the attention of the chief European countries, and numerous are the methods which have been suggested to overcome the difficulties. Interest in the subject has not been solely confined to the political and social arena, for it offers tempting problems to the insurance world at large, compelling its attention and necessitating assistance from those whose profession qualifies them to advise upon the practical working of a system. Apart altogether from the fact that we in this country have only recently admitted the justice of the principle, it will be found that Continental countries have availed themselves of this professional assistance to a much greater extent than in England, and that they have given more consideration to actuarial deductions and theories, with the result that their schemes have necessitated State management to the exclusion of the private insurance companies. The secret of the weak and faulty system which has been established in Great Britain may perhaps be attributed to an endeavour to avoid this result, although the exclusion of private companies need not necessarily be the result, as Continental schemes recently introduced have proved.

The method by which the cost incurred is charged against the trade or employer forms the chief difference between the systems so far instituted; little, if any, material difference occurring between the other principles of the schemes and that which was

originally instituted in Germany, and it may truly be said that the German system has formed the basis of, and had its influence upon, every subsequent scheme.

Continental Systems.

The German system is an elaborate organisation of compulsory insurance under the direct supervision and control of the State. This has been gradually extended, with the result that it now applies to employers of labour and workers of every description throughout the country. Under the German law all employers are compulsorily enrolled in one or other of the Mutual Trade Associations according to their trade and district, and there are similar organisations in connection with the State and municipal authorities. The enrolment of employers is simultaneous with their initial entrance into business. The amount of compensation is on a fixed scale, which may reach, but never exceed, two-thirds of the wages, according to the extent of the disability. It is payable during the whole period of disablement, and is calculated from the fourteenth week of that disablement, all previous disability being provided for under the obligatory sickness scheme, to which the employers contribute one-third of the premium. In the event of death, fixed funeral expenses are given, and compensation, in the form of annuities of a percentage of the deceased's wages, is paid to the widow and to each child and to progenitors if dependent on the deceased, but in no case exceeding a total of 60 per cent. of such wages payable during the life of the recipient, or until re-marriage, or, in the case of children, until the age of fifteen is reached. All costs of investigations are borne by the trade association, and the payment of the compensation is effected through the Post Office.

The method adopted for meeting these expenses is as follows:— The sums paid by the Post Office on behalf of each Association are recovered from them, and these amounts, together with expenses of management and the stipulated assessment for the reserve fund, are collected by the Association from its members in their several proportions and in accordance with their risk classification. This classification or sub-division into grades of risks is revised every five years. The percentage apportioned to each class is fixed by the Association subject to the approval of the State Office. The reserve assessment, which is a pre-

cautionary measure recently adopted, is a gradually reducing percentage on the amount of compensation to be levied, commencing with 300 per cent. on the first assessment and ending with 10 per cent. on the eleventh assessment. Provision is made for dealing with the interest on this reserve fund after the eleventh year.

The system is practically the American Life Assurance Assessment plan adapted to compulsory insurance in trade associations, each Association classifying or sub-dividing its members according to the degree of danger in their employment, and apportioning to each class a fixed percentage or rating of the actual yearly outgo plus the percentage assessment for creating a reserve fund.

A slightly different method is adopted by the Underground Builders' Associations owing to the fluctuating nature of the business of their members. They calculate, according to a table prescribed by Government, the total sums required to capitalise the future annuities in respect of all allowances payable at the close of the year, and deduct from the total the amount of the fund resulting from previous years and remaining over after payment of the allowances made during the year. The difference between these two sums is the covering capital required for the year. The expenses of management and the single and temporary allowances made during the twelve months are added to the covering capital, and the resulting sum is apportioned among the members on similar lines to those of other associations, but they are required to make quarterly advances towards their yearly contributions.

Austria, which was the next to legislate in this direction, followed somewhat on the same lines, but the Austrian Act does not apply to all workers. Small workshops without machinery, and agricultural labourers except when working with machinery, are not included. In the case of non-fatal accidents, the compensation allowance is limited to 60 per cent. of the wages, but it commences on the fifth week instead of on the fourteenth. In the event of death the compensation allowances to dependants are a percentage of the wages of the deceased, but the total maximum must not exceed 50 per cent. of such wages, instead of 60 per cent. as in Germany. Territorial, instead of trade associations, are established, the only exception permitted being in the case of the railways, which have a separate or trade association exclusively their own.

Instead of adopting the German assessment method, Austria charges premiums calculated to cover not only the actual amount paid in compensation in the course of the year, together with expenses, but sufficient to meet the total liability estimated to be incurred in respect of the risks undertaken during the year. The trades are classified according to the risks of employment, and rates of premium have been fixed for same. This classification and rating is revised every five years. The data upon which these rates were first calculated were a combination of German and Austrian statistics, actuarial assumptions and suppositions; but experience has necessitated a considerable alteration in the original rates.

In the French system, which has only recently been formulated, the compensation is on the German and Austrian lines, but it commences on the fifth day of disablement, as no sickness insurance scheme is in operation in that country. The law provides for the proper notification of accidents, but, while not specifically making insurance compulsory, it goes a long way in the direction of compelling the employer to insure. The payment of the compensation is guaranteed by an original and ingenious system of compulsory guarantee of solvency by the employers, either by insurance with an accident insurance company, which, in its turn, is compelled to deposit with the State varying sums as security for its solvency, or by a payment of a small annual sum to a special State Guarantee Fund which will assume the full liability for the compensation payments in the event of bankruptcy either of an individual employer or a company.

Variations in the systems have also been made by Switzerland and other Continental countries; and, in a new Bill which is being brought forward in Belgium, the novel proposition is made to base the calculations of the annuities to dependants on the age of the deceased workman instead of making it to depend on the lives of the beneficiaries as in other countries.

Such is a brief outline of the principal Continental systems, each differing materially in the method adopted for providing the necessary funds, but all of which safeguard the interests of the workman on whose behalf the legislation was enacted.

English System.

In Great Britain no such definite system exists, nor is it possible to place before you in a condensed form the scope of the

English statute affecting my subject. Legislation in the direction which we are considering is, however, of such recent date, and the whole subject of "employers' liability to workmen in their employ" has been dealt with so fully by me in previous papers,* that it is unnecessary for me to trouble you with its details on this occasion, and for my purpose this evening I will assume that you are conversant with those details.

Much has happened during the eighteen months in which the Workmen's Compensation Act, 1897, has been in operation to emphasise many of its defects, and enable us to criticise its working; but before doing so let us consider the main features of the obligation entailed upon us by an acceptance of the principle which I enunciated at the outset of my paper. To do this it will only be necessary to recall the statements and promises made by the Government during the passing of the measure through Parliament, and we shall then be in a position to realise the shortcomings of the Act which was intended to carry out those promises.

Sir Matthew White Ridley, the Home Secretary, in introducing the Bill, 3rd May, 1897, after briefly reviewing the situation and criticising Mr. Asquith's Bill of 1893, said :—

> When the Government came to consider this problem, it seemed to us that we had two alternatives before us —one the alternative of adopting something like the provision of my right hon. friend opposite, adding to it, as we were pledged to do, the power of contracting out. The other alternative we had was to propose a scheme of general compensation, under proper safeguards and necessary limitations, and apply it to industries to which it would appear, in the first instance, it could properly be applied. Therefore we had to make our choice between the general application as my right hon. friend applied it, and the limited principle. It will be found . . . . that . . . . we have chosen the latter course. . . . . It (the Bill) proceeds on the principle, which I will venture to quote from the words used by my right hon. friend in 1893, that "when a person, on his own responsibility and for his own profit, sets in motion agencies which create risks for others, he ought to be civilly responsible for what he does." In our Bill we accept the principle laid

* "Employers' Liability; its History, Limitations, and Extensions." *Post Magazine*, 12th December, 1896, p. 840. *Journal Federated Institutes*, Vol. I., page 269. "The Workmen's Compensation Act, 1897"; "The Employer and the Insurance Companies." *Post Magazine*, 19th March, 1898, page 199.

down by the right hon. gentleman, and we accordingly propose in the first clause that "If in any employment to which this Act applies personal injury by accident arising out of or in the course of employment is caused to a workman, his employer shall be liable to pay compensation in accordance with the first Schedule of this Act."

We admit that the Bill embodies a new principle. It is a new departure, and I can quite imagine that there will be some criticism, not only upon the principle, but upon the details. The House has first got to settle the question—Is this principle sound, or is it not? I venture to think, if you look at what is going on elsewhere, not less than at the growth of public opinion in this country, and at what has passed in Parliament itself, you will see that there is a growing feeling that it is proper, in the sense of the words of the right hon. gentleman opposite, to make trades responsible for the risks which they create. Well, then, is its application fair and reasonable? That is, of course, a matter for argument. . . . . It (the Bill) is defined and limited so that both parties may know where they stand; it provides an inexpensive method of settling questions that must arise; and if it be true that legislation of this kind ought to aim at being simple, immediate, and effective, this Bill has been conceived with that object. We desire that it should avoid litigation, and that it should give the workmen of this country the right to compensation for those accidents which, unfortunately, must occur in the course of their industry, and we believe that we can do so without inflicting an unjust burden on the employers.—*The Times*, 4th May, 1897.

Mr. Chamberlain, on the same evening, in the course of his speech, said:—

If you consider that, under the existing state of the law, something like 12 per cent. only of accidents are in any way dealt with in the shape of compensation, the House can understand that a Bill which is going to bring in for the first time 88 per cent. more is a measure of such importance that it may well stand on its own bottom. . . . . I have pointed out that one object of the first importance of our Bill is to get rid of litigation. We have attempted to do that in several ways by the simplicity and definiteness of our proposals. If a man is injured in the course of his employment he is no longer asked any question as to how the injury was sustained. He is in every case a subject for compensation. He is not asked what the amount of compensation is to be, or, at all events, he is only asked very limited questions in regard to it, because a *maximum* payment equivalent to half his wages is the sum which is fixed under the Bill as being the *maximum* payment that he can receive. Mean-

while, I say it is an honest attempt to deal with a great evil —with what I have ventured to call a great scandal—namely, that industrious, honourable workmen who come to trouble through no fault of their own in the course of their employment, and as the inevitable and consequential risk of that employment, should be turned into the street and thrown upon the rates without anything in the nature of legal compensation. That has always seemed to me to be neither more nor less than a scandal. I believe we shall achieve a great object if we relieve this class of the community . . . . The difficulty has been hitherto that there was no certainty that the legislation which we were passing would benefit the workman for whose advantage it was really intended. . . . . I think this Bill is based upon a different principle to either the old Employers' Liability Act or the Bill of the late Government. It is based upon the principle of relieving the workman and not of punishing the employer. I have said we are dealing with the whole of the accidents which occur in the course of employment, and nobody has ever pretended that the accidents for which the employer is morally liable have ever amounted to more than a mere fraction of the whole. . . . . And I am certain the Bill will be recognised as a great boon by the employees themselves.—*The Times*, 4th May, 1897.

On the second reading (17th May, 1897) Sir Matthew White Ridley dealt more particularly with the employments to be included under the Act, and I quote the following to show his estimate of the number and description of the workpeople to be benefited thereby :—

Every trade which may fairly be called dangerous is included, except that of seamen. . . . . I take the number of workmen in factories, docks, and wharves as 3,600,000 ; in mines, 730,000 ; on railways, 465,000 ; and in quarries, 104,000. As to the remaining class included—namely, those employed in engineering works—I find it extremely difficult to ascertain the number. There are a great many builders and bricklayers, something like 700,000 ; and under the description of general labourers and navvies another 800,000 might fairly come. At all events, there will be included in this Bill as at present drawn some 6,000,000 at least of the workmen of this country. Outside the Bill there are those employed in agriculture, whom I estimate at 1,700,000 ; seamen and fishermen, about 192,000 ; domestic servants, 2,300,000 ; workshops I roughly estimate at 2,000,000 ; shop assistants, 500,000 ; transport services, 600,000—which gives a total of something over 7,000,000.—*The Times*, 18th May, 1897.

Herein lies the obligation, an obligation which the Government openly undertook and promised the country to carry out :—

1. Compensation to be given for the whole of the accidents which occur in the course of employment or arising from the employment.

2. Compensation to be definite, and procedure to obtain same so simple, immediate, and effective, that litigation would no longer be necessary.

3. The Act to include some 6,000,000 workmen at least, and only exclude seamen, fishermen, domestic servants, workshops, shop assistants, and those employed in agriculture and transport.

There is no ambiguity about the statements I have quoted, and all who followed the discussions during the various readings of the measure cannot fail to have observed that all the speakers—supporters and opponents alike—argued under the belief that the Government honestly intended to effectively put into operation the principle they had laid down.

Let us now turn for a moment to the Act itself and ascertain the exact words employed by the Government for this purpose.

Clause I. (1) follows closely the wording used by the Home Secretary, but instead of using the word *or*, as he did, it reads, "arising out of *and* in the course of the employment."

Clause VII. (1) provides that the Act shall apply only to employment by the undertakers . . . on or in or about a railway, factory, mine, quarry, or engineering work, and under certain conditions to buildings and building operations.

Defects of the English Statute.

We may naturally assume that the exact wording of the Statute was left to the Law Agents of the Crown, with definite instructions as to its scope and to pledges given. It is therefore difficult to account for its ambiguity and for its proved legal defects.

Judges even in the High Courts express their inability to understand its clauses, and unanimously find fault with its clumsy draughtsmanship. Each week the Appeal Court has been engaged in deciding some contested point, and its decisions are gradually narrowing down the scope of the Act and the meaning of its clauses.

It has been decided that an unfortunate workman or his dependants are not entitled to claim compensation, because—

The place in which the accident occurred was not the factory of the employer, but the factory of someone else.—*Francis* v. *Turner*, *The Times*, December, 1899.

That the workman was not employed in a dock, because he was receiving cargo in a ship's hold from the ship's crane, instead of the crane on the dock wall.—*Hennessey* v. *M'Cabe*, *The Times*, 9th December, 1899.

That he was repairing a house by means of a ladder, not a scaffold.—*Wood* v. *Walsh* (1899), 1 Q.B. 1009 (C.A.).

And that the accident only arose *in*, that is during the course of, the employment, and not *out of and in* the course of the employment.—*Cheeseman* v. *Nightingale*, 107, *Law Times*, 237.

All this, were it not for the serious consequences which are the outcome of ridiculous legal quibbling, would have an element of humour that is grim.

Then on the question of compensation and litigation.

To the ordinary layman, under Section I. (a) (1) Schedule I. of the Act it appeared quite clear that £150 was the minimum sum to be paid in all cases where a deceased workman left dependants wholly dependent upon his earnings; but the Court of Session in Scotland decided that the dependants of a dock labourer were only entitled to £32 9s. 2d.—*Small* v. *M'Cormick and Ewing*, 6th June, 1899, 36, *Scottish Law Reporter*, 700.

Two decisions have also been given which have the effect of compelling every injured workman to bring his claim before the Courts, or otherwise his employer may cease paying him the weekly compensation provided by the Act at the end of six months, and the workman has no means of compelling further payments; in other words, a claim, although duly notified and admitted by an employer for six months, can then be repudiated irrespective of the condition of the workman unless the workman has within that period brought the legal claim before the Courts. *Bennett* v. *Wordie and Company*, 16th May, 1899, 36 *Scottish Law Reporter*, 643. *Marno* v. *Workman, Clark and Company*, 24th November, 1899, Recorder's Court, Belfast.

Then there is the recent judicial decision, or, to be absolutely correct, opinion expressed by Lord Justice A. L. Smith, 11th November, 1899, and with which Lords Justices Collins and Vaughan Williams apparently concurred, which is of sufficient importance to warrant my quoting it in detail.

The appeal was from an award of the Liverpool County Court Judge in the case of Williams *v.* Poulson :—

Mr. Ruegg, in stating the case for appeal, said the question involved was one of considerable importance, the point being as to how the compensation was to be estimated in a case where the injured person was a workman in the employ of a number of employers. The plaintiff, a dock labourer, at various times during the past year had been employed by the defendant, a master stevedore, his daily earnings being 5s.; and he also had worked for other master stevedores. At the time the accident which incapacitated him happened, he had worked for three and a half consecutive days in the employment of the defendant. The Liverpool County Court Judge, in computing his "average weekly earnings" for the purpose of compensation, took the total sum earned by him while in the defendant's employ during the previous twelve months, which amounted to £38 13s. 6d., divided it by 52, the number of weeks in the year, halved the result, and on that basis awarded compensation of 7s. 6d. a week. The labourer now appealed for a larger award. Mr. Ruegg argued that the award of the County Court Judge was founded on a wrong basis. What he should have done was to have taken the plaintiff's whole earnings for the year, when the average would have been 28s. for each week, and the award nearly double that given. The County Court Judge held that the money the plaintiff received from other stevedores who employed him could not be taken into account; but if that were so, then this startling state of things arose—If a casual labourer were employed by each employer for one day only in each month of the year, and then his twelve days' earnings were to be added together, divided by 52, and the result halved, the compensation would only amount to a few pence. That, counsel submitted, could not have been the intention of the Act of Parliament when it spoke of "average weekly earnings."

Lord Justice Smith did not think the plaintiff in the circumstances came within the Act at all.

Mr. Ruegg submitted that a labourer engaged in such work must come within the Act.

Lord Justice Smith—Then he must come within the Act without any machinery for assessing his compensation. We have had to put painters engaged in painting a house outside the Act. I would have put them in if I could.

Mr. Ruegg said his point was that the Act must be read to mean that where a workman had not been employed for so long a period as twelve months by the employer in whose service he received his injuries, then his average must be calculated on his weekly earnings during the period in which

he had served that employer. Where a man worked three days at 5s. a day his average weekly earnings would be 30s.

Lord Justice Smith pointed out that the Act took a week as the unit, and plaintiff had only worked three and a half days since the last break in his engagement.

Lord Justice Vaughan Williams—Suppose a builder employs a steeplejack for a day on dangerous work and pays him £5, do you say that his average weekly earnings in that employ are £30?

Mr. Ruegg acknowledged that that was a difficulty, but it arose from the wording of the Act itself.

Lord Justice Collins—Certainly it does; but it is not our business to amend the Act. The Legislature had some reason for insisting that it must be the same employment. They connected the liability of the employer with the wages paid by him and not by another employer.

Lord Justice Smith—I doubt very much whether you can get a man into this Act who goes into new employment and gets his leg cut off the first day.

Mr. Ruegg—This is a most startling thing.

Lord Justice Smith—A lot of most startling things come under this Act.

Mr. Ruegg argued that the Act was intended to insure against such accidents as that in this case, but according to Lord Justice Smith a workman until he had completed a full period of a week's work remained absolutely uninsured.

Lord Justice Vaughan Williams observed that the whole basis of the Workmen's Compensation Act was that the workman's injuries were to be chargeable to the profits of the industry, and if he had been employed for less than a week, then his Lordship did not see why injuries should necessarily be chargeable. A workman, of course, was left his remedy under common law and the Employers' Liability Act.

Mr. Ruegg said that in view of the strong expressions of opinion from their Lordships, and the position into which they had driven him, he doubted if it would be in his client's interest that he should ask for the award to be overruled.

Lord Justice Smith suggested that the appellant's best course would be to withdraw the appeal and keep the 7s. 6d. awarded.

Mr. Ruegg said that, as the case was one of such importance, he did not feel at liberty to withdraw the appeal at present. It might be necessary to take the opinion of the House of Lords on the matter.

The case was then adjourned in order to give the learned counsel an opportunity of considering what course he should adopt.—*Liverpool Mercury*, 13th November, 1899. Court of Appeal, 11th and 18th November, 1899. *The Times*, 20th November 1899.

These expressions of opinion by the Judges of the Court of Appeal are of such vital importance, and affect such a large number of workmen hitherto believed to be included within the Workmen's Compensation Act, 1897, that it was impossible to allow them to pass unnoticed, and accordingly the General Secretary of the National Union of Dock Labourers in Great Britain and Ireland wrote to Mr. Chamberlain as follows :—

"The Right Hon. Joseph Chamberlain, M.P.

"Dear Sir,—As you were the most prominent advocate of the Workmen's Compensation Act, now become law, and I understand had much to do with the framing of the Act, I would feel extremely obliged if you would explain whether it was the intention of the framers of the Act in question that casual labourers, who include pieceworkers, and whose occupations were admittedly within the scope of the Factories Act, are to be excluded from all benefits.

"I am prompted to ask you this because of the point which is now being raised with respect to members of our trade (which is covered by the Factories Act), and which, if excepted, will exclude at least sixty per cent. of the workpeople for whose benefit the Act was intended. The Judges of the High Court in the case of Williams *v.* Poulson, though they have not definitely decided the point, have already given an *obiter dictum* to the effect that men casually employed and not in the receipt of weekly wages are not within the meaning. A reply at your earliest convenience will oblige.—Yours respectfully,

"JAMES SEXTON, General Secretary.

"Liverpool, November 20."

The following is Mr. Chamberlain's reply :—

"Sir,—I am directed by Mr. Chamberlain to acknowledge the receipt of your letter of Nov. 20, and to say that of course he is not able to give a legal opinion, but that when the Act was passed he certainly had no idea that pieceworkers or casual labourers if engaged in *boná-fide* employment could or would be excluded from the benefits of the measure.—I am, sir, yours obediently,

"J. WILSON.

"Highbury Moor Green, November 27."

Gentlemen, need I furnish you with further examples? I think not! It may interest you, however, to hear other views of its shortcomings, and I will therefore read you some extracts from a paper by Mr. Joseph Shaughnessy, solicitor, of Glasgow, read before the Incorporated Society of Law Agents in Scotland, at their annual meeting in Glasgow, 5th October, 1899:—

> There has been no Act passed within recent times which, within such a short time, has led to so much litigation. . . . . Such a state of matters shows clearly that, in spite of the great attention paid to the framing of the Act, the phraseology of it has been loose. . . . . For example, Lord Young holds that a contractor (and a contractor may be a single individual without any employees) is a workman to whom the 1897 Act applies. The Lord Justice-Clerk and Lords Trayner and Moncreiff are of a different opinion. Lord Trayner is of opinion that a person who employs someone to repair a building is not the "undertaker" of the repairs under the Act. Lord Young is of opinion that he is. Lord Moncreiff is of opinion that a contractor's servants have no claim against the owner of a property where the owner does not himself engage in the work. Lord Young is of a different opinion—namely, that he is liable. Again, there are many cases of hardship as to the meaning of the words "arising out of" and "in the course of" employment. . . . . But no part of the Act has caused such litigation and difficulty in understanding as that referring to the definition of what is a "factory." The Act provides that it is, *inter alia*, to apply to employment by the "undertakers" on, in, or about a "factory," and a factory is defined to have the same meaning as in the Workshops and Factory Acts, 1878 to 1891, and to include a dock, wharf, quay, warehouse, machinery, or plant to which any provision of the Factory Acts is applied by the 1895 Act. It is very difficult to piece together these various Factory Acts, and find out whether the employment is one to which any provision of the Factory Acts applies. It would surely be the easist thing in the world, no matter how bulky the Act might be, to embody everything in a schedule attached to an amended Act, so that there could be no ambiguity as to the employments to which the Act applies, etc., etc.

The Insurance Companies and the Act.

With such a conflict of judicial opinion as to the scope and meaning of the Act, can you wonder at the difference of opinion which existed among insurance officials on the subject of the cost which the Act would entail upon the trades affected?

You will all recollect that before the Act came into operation representatives of the various companies united in forming an Accident Offices Committee, and endeavoured to estimate the rates of premium which would be necessary for the safe conduct of the business. The members, however, through various causes gradually resigned, until eventually there were only three original members left on the committee. Under these circumstances it was useless to continue the uneven struggle, and at the present moment all hope of maintaining standard rates has had to be abandoned. If I were asked to summarise the history of the crisis, I should say—

At the outset, all the companies prepared to act in accordance with the spirit of the Act. Fear of competition induced one or two of the offices to hold aloof, so that they could secure business by accepting slightly lower rates. Their action, coupled with the misleading statements and advice of at least one member of the Government, necessitated the withdrawal of others, and the result has been that rates have been reduced below those at which the spirit of the Act can be honestly carried out, and legal ingenuity has been called upon to assist in whittling away the benefits originally intended to be given to the workman, and advantage has been taken of his ignorance, wherever possible, to make the business pay by depriving him of that to which he was entitled. Truly, a serious charge to lay at the door of any Government.

Two illustrations culled from the public press will serve to illustrate the justice of my remarks—

> At a meeting of the Council of the South Wales Miners' Federation at Cardiff, 25th November, 1899, it was reported that an aged workman named David Holding, having been permanently injured at the collieries of the Ebbw Vale Company, had been induced to sign an agreement accepting the sum of £1 as the total sum of compensation, and freeing the company from any further liability. Messrs. Alfred Onions and Evan Thomas were appointed a deputation to wait upon the representatives of the Ebbw Vale Company.—*South Wales Echo*, 25th November, 1899.

My second illustration is rom the pages of the *Policy Holder*, which, under the heading "Workmen's Compensation Day by Day," prints the following—

> A re-insuring company recently received a letter from an office with whom it had dealings, to the effect that it had succeeded in settling for £50 a claim upon which they

were clearly liable for £250. The office which had re-insured its risk thought that it had been very smart in getting out of its liability so well. Did it ever occur to the gentleman who settled the case that he was acting dishonestly? The office undertook to honourably discharge all honest claims which might arise under the policy. That is the light in which few offices regard the situation, we fear. Rates are cut, and then all manner of means are resorted to to make the business pay, if possible. This is the present state of affairs, but we trust, for the honour of insurance business at large, that companies will view their responsibility in a different light in the future.—*Policy Holder*, page 674, 30th August, 1899.

Criticisms and Suggestions.

In this brief survey of the English Act and its working I have striven to emphasise its shortcomings as a specimen of legislation specially enacted to benefit the workman and to carry out the principle put before you. There are other sides to the question I freely admit, but these I do not wish to discuss. We have admitted the principle, and, like our neighbours on the Continent, should effectively put it into operation.

Not that the Continental systems are perfect, or that the two actually in active operation have not been found wanting, but their shortcomings do not directly affect the principle involved. The defects of their system concern more particularly the apportionment of the cost. We need only turn to the report of the International Congress on Accidents from Work, which was held in Brussels in 1897, to learn how many are the defects of the German and Austrian systems in this respect, and the result of the discussion which took place at that Congress is admirably summed up by M. L. Maingie, Fellow of the Belgian Actuarial Association, as follows:—

"The situation left by the Paris Congress of 1889 has been modified. Instead of eulogies, three writers addressed lively criticisms to the mathematical structure of the systems in force in Germany and Austria.

"The scientific discussion was opened on the last day. The worthlessness of assessmentism and its corresponding methods has been technically demonstrated. What is the result of the discussion? In my opinion a victory for sensible scientific notions, and

a considerable shattering of an almost general belief in the stability of the German and Austrian systems.

"With regard to this, this one day's work of the Brussels Congress seems to have been decisive. It has allowed actuaries to affirm, without being contradicted, the scientific insufficiency and the danger of servile imitations of the legislation in force in Germany and in Austria." (*Translation.*)—*Bulletin*, Comité Permanent des Congrès Internationaux d'Actuaires, No. 2, 15th December, 1897.

In view of such adverse criticism we are not surprised that the proposed Belgian law adopts a different basis for awarding compensation to dependants, thereby dispensing with much of the difficulty and uncertainty in estimating the cost which would otherwise be incurred owing to the lack of definite statistics. In this respect their system is scientifically a great advance upon others, but it has yet to be proved that it is more practical in its working and as equitable to the workman and his dependants.

To what extent, if at all, the actuaries can assist us in this country remains to be proved, but I need only recall the controversy between the Government and Mr. Neison at the time the Workmen's Compensation Bill was under consideration (*The Times* 26th and 28th May, 1899) to show how helpless they are in the absence of definite statistics and how divided are their opinions on the subject; nor can we feel in the least surprised that this should be so after what I have said as to the inherent defects of the Act and the numerous difficulties we have encountered in connection with it.

It is these inherent defects of the English Act which call for immediate attention, chief among them being that—

1. It absolutely fails to provide for the unavoidable accidents to human life arising in the course of employment, which is the principle involved.
2. It lacks precision as to the employments involved.
3. The scale of compensations to be awarded is indefinite.
4. The workman has absolutely no security that he will receive the compensation to which he is entitled.

To remedy the first two defects should be a simple work, but the third and fourth will present considerable, but we hope not insurmountable, difficulties.

No sooner do we commence to consider the scale of compensa-

tion, even when absolutely defined, than we are confronted with the difficulty alluded to at the outset of my paper. What will be the ultimate cost of applying that scale to a particular industry? This can only be determined by accurate statistics as to the—

a. Risk involved in that particular industry.

b. The wages earned.

c. The age, sex, and condition—single or married, with or without dependants—of the workpeople employed.

d. The duration of permanent disablement annuities.

But such statistics are not available, and how they are to be obtained is a problem yet to be solved.

Here the Government could assist if they wish to do so and if they really desire to put the principle into force.

What is required is a compulsory systematic registration by the employer of all accidents, however trivial their nature, the description of workman, wages earned, and stating if insured. Each year he should be required to make a return of the number or of the average number of workpeople employed, accurately classified, and stating the average wage paid. It would be necessary to classify all employments under various heads, so as to distinguish these returns; and the existing channel for notification, viz. the factory inspectors and medical officers, could still be utilised. All the Government returns and statistics should be made upon the lines suggested, and a uniform method should be adopted by all Government Inspectors when furnishing their returns. We must admit that there has been an improvement in the returns during the last year or so, but the figures supplied are almost valueless for our purpose, because the tables containing these figures are not uniform in style, and the particulars as to the number of workpeople concerned are so long delayed.

These returns should be supplemented by an annual return from the Insurance Companies, similarly classified, giving summaries of the number of accidents notified and dealt with by them, with duration of disablement; and they should be required to periodically return an actuarial valuation of the reserve for permanent disablement cases on their books, somewhat on the lines of the returns under the Life Assurance Acts, 1870 and 1872. This latter suggestion was ably formulated by Mr. Linnell in a letter in *The Times* of 27th April, 1898 :—

WORKMEN'S COMPENSATION ACT, 1897.

To the Editor of the Times.

Sir,—This Act comes into force on July 1 next, and by its very terms Parliament appears to have recognised that insurance in some form or another would, in the great majority of instances, constitute the employers' only safeguard from a novel and indefinite liability. It appears that employers are recognising their position and making arrangements accordingly.

So far as fatal injuries are concerned the liability is more or less definite.

Where total or partial incapacity for work results from the injury, the workman is entitled, after the second week, to a payment during incapacity not exceeding one pound a week. Where any weekly payment has been continued for not less than six months, the liability therefore may, on application by or on behalf of the employer, be redeemed by the payment of a lump sum to be settled, in default of agreement, by arbitration.

In the case, therefore, of non-fatal injuries the liability is indefinite, and there is great danger that insurance companies or mutual schemes may be found to have accumulated enormous liabilities in respect of cases of permanent total or partial disablement without the necessary reserves to meet them, for it is obvious that, where under the stress of competition inadequate premiums have been charged, and funds are limited, there will be little probability of the clause being availed of which provides for the extinction of liability by the payment of lump sums. In such cases insolvency must follow, and the liability will recoil on the individual employers.

How, then, are the employers to be protected from what may be practically insolvent institutions, although the latter's accounts may give no indication of impending doom? I would strongly urge that the precedent of the Life Assurance Companies Acts of 1870 and 1872 might be advantageously adopted, and that all offices or mutual schemes granting insurance under this Act should be compelled to deposit annually with the Board of Trade, for submission to Parliament, accounts prepared in a prescribed form, and periodically (biennially or triennially) schedules of all outstanding liabilities, together with an actuarial valuation thereof.

A timely intimation by the Government of an intention to frame such a form of accounts and schedules, and to pass the

necessary short Act, would minimise the risk of a recurrence of scandals and disasters similar to those which brought about the passing of the Life Assurance Companies Acts above referred to.

The deposit by Insurance Companies of £20,000 with the Board of Trade, pending the accumulation of an insurance fund of a certain magnitude, might also be usefully insisted on to check the promotion of mushroom companies.

I am, Sir, your obedient servant,

E. Linnell.

63 Threadneedle Street, E.C.,
April 25th, 1898.

Such compulsory notification would, I think, enable the working of the Act to be properly criticised, and would do much to counteract the fourth defect to which I alluded.

I am aware that there is a strong feeling of prejudice against compulsory legislation of this kind, but what I propose is mild compared with what is in force in other countries and with what has to be complied with by those British offices transacting business abroad.

I would remind you that this great social question cannot be ignored. It has taken too strong a hold, and the principle upon which it is based is too just to permit of our doing so, nor does my proposition press unduly upon either side; it is equally of interest to the employer and the workman, for it is absolutely necessary to safeguard industry—in the person of the employer—from oppression, just as it is to ensure that the workman shall be entitled to and receive equitable compensation.

We Insurance Companies are equally interested in an equitable adjustment of the difficulty, for by some such adjustment we shall safeguard our co-operation, while at the same time we shall further that grand beneficent ideal of providing for the need of the deserving industrial community during incapacity from work, whether arising from sickness, accident, or old age.

C. H. GREEN.

Insurance Institute of Yorkshire,
26th January, 1900.

FEDERATION OF INSURANCE INSTITUTES OF GREAT BRITAIN AND IRELAND.

To the Secretary of the......................Institute.

DEAR SIR,

EXAMINATION, MAY 7TH TO 12TH, 1900.

I am instructed to inform you that simultaneous Examinations will be held in the order, and on the dates named below, and to request that you will make all necessary arrangements for carrying the scheme into effect at your centre.

Date.	Subject No.	Subject.	P.M.
Monday.	1	Electricity.	6 to 8.
,,	14	Employers' Liability Insurance.	6 ,, 8.
,,	19	Commercial Book-Keeping, &c.	6 ,, 8.
,,	4	Processes of Manufacture (Flour Milling).	8.5 ,, 9.5.
Tuesday.	18	Life Assurance, &c.	5.55 ,, 8.55.
,,	6	Processes of Manufacture (Machine Making).	5.55 ,, 6.55.
,,	8	Tariffs (Corn Mills).	7 ,, 8.
,,	11	Policy Drafting (Corn Mills).	8.5 ,, 9.35.
Wednesday.	17	Mathematics.	5.50 ,, 8.50.
,,	7	Tariffs (Woollen Mills).	5.50 ,, 6.50.
,,	3	Processes of Manufacture (Woollen).	6.55 ,, 7.55.
,,	10	Policy Drafting (Woollen Mills).	8 ,, 9.30.
Thursday.	15	Correspondence (Fire).	5.50 ,, 6.50.
,,	16	Do. (Life).	6.55 ,, 7.55.
,,	13	Law of Fire Insurance.	8 ,, 10.
Friday.	9	Tariffs (Tanneries).	5.50 ,, 6.50.
,,	12	Policy Drafting (Tanneries).	6.55 ,, 8.25.
,,	5	Processes of Manufacture (Leather).	8.30 ,, 9.30.
Saturday.	2	Plan Drawing to Scale.	2 ,, 4.

To ensure absolute fairness to every competitor, it is essential that the procedure shall be clearly defined and uniformly carried out at each centre. I have therefore to ask that the Conditions and Rules laid down in this Circular be strictly observed in every detail.

The Examination Papers for each evening's Examinations will be sent to you in a sealed parcel, by post, the preceding evening, and it will be your duty to hand the parcel unopened to the presiding officials.

May I ask you to arrange that such desk or table accommodation be provided as will allow proper spaces between the candidates? A supply of ruled paper will be required in connection with each of the Examinations, as there will be no space on any of the Examination Papers for replies, and you are requested to supply four single foolscap-sized sheets ruled brief paper for each subject. It would be well to have a reserve supply available on each evening for use if required, as, while some subjects will not require four sheets, others may require more.

Each Institute or other appointed centre must take the responsibility, at its own cost, of providing a suitable room, and supply, or arrange with competitors to supply, pens, pencils, rubber, ink, Surveyors' scales, blotting paper, and any other necessaries as may be requisite.

It is imperative that the Examinations be held in the order, on the days, and at the times named. Any failure on the part of an Institute to provide the necessary facilities and supervision would result in the disqualification of all the candidates for examination from that centre.

You will be good enough at once to distribute the printed instructions to competitors sent you herewith amongst the competitors at your centre, and to provide each Superintending Official with a copy of this Circular.—I am, yours faithfully,

J. B. ROBERTS,
Hon. Secretary to the Examiners.

SUN BUILDINGS,
LEEDS.

RULES AND REGULATIONS FOR GUIDANCE OF PRESIDING OFFICIALS.

(1.) The Examinations each evening shall be under the personal superintendence of two official members of your Institute, who shall be present and preside during the whole of the period covered by one evening's Examination; but it is not essential that the same two individuals shall officiate each evening.

(2.) No person other than the presiding officials and the competitors shall be allowed in the room between the opening and closing of an Examination.

(3.) The sealed packet containing the Examination Papers shall be opened by the two superintending officials in each other's presence, and distributed not earlier than five minutes before the time fixed for commencing the Examination, but competitors shall not begin until the actual time for commencement is announced by the officials.

(4.) Competitors shall not be allowed to leave the room, except in case of urgent necessity and accompanied by one of the officials, nor to converse or in any way communicate with each other, or with the superintending officials, during the progress of the Examination; nor to peruse, consult, or in any other way utilise any written, typed, or printed book, document, rules, Tariff, or other printed, written, or typed matter whatsoever, save and excepting only, that on the Examination in Subjects 10, 11, and 12, competitors may be allowed to use the Woollen Mills, Corn Mills, and Tanneries Tariffs, and the printed Warranties connected therewith. These Tariffs and Warranties must be provided by the competitors themselves, and a copy of the latter attached to the draft. It is the duty of the presiding officials to enforce the strict observance of this rule, any breach of which, if discovered, would result in the disqualification of the competitor.

(5.) If a competitor, after taking his seat for examination, be desirous of withdrawing from the competition, he shall immediately and silently leave the premises, first handing the Examination Papers to the presiding officials.

(6.) No extension of time can be allowed in connection with any subject under any circumstances.

(7.) Immediately on the expiration of the allotted time, the officials shall notify the fact to the competitors, who shall, without a moment's grace being allowed, cease work, every paper (whether finished, unfinished, or cancelled) being at once handed to the presiding officials. The competitor must write his name and address on the gummed slip provided for the purpose, and this must be attached to the left-hand top corner of the first sheet of the competitor's replies; the sheets, if more than one, to be neatly pinned together. The space for the number on the gummed slips must *not* be filled in. Competitors must write on one side of paper only. The presiding officials, in collecting the Papers, should see that each one has a slip attached as directed. Each subject must be tied in a separate batch, and the whole returned to the Hon. Sec. to the Examiners by the same evening's post. A note, signed by the presiding officials, should accompany the Papers, certifying the observance of, or reporting any departure from, these Rules and Regulations.

(8.) When two or more subjects are being competed in at the same time, the competitors should be seated in separate groups, so as to facilitate the collection of Papers and prevent annoyance to those remaining. Competitors in the subjects with the shorter time allowances shall at once withdraw on the expiration of the time allotted to their particular subject, after duly handing in their Papers as directed.

INSTRUCTIONS TO COMPETITORS.

Examination, May 7th to 12th, 1900.

Simultaneous Examinations will be held in the order and on the dates named below :—

Date.	Subject No.	Subject.	P.M.
Monday.	1	Electricity.	6 to 8.
,,	14	Employers' Liability Insurance.	6 ,, 8.
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,,	5	Processes of Manufacture (Leather).	8.30 ,, 9.30.
Saturday.	2	Plan Drawing to Scale.	2 ,, 4.

To ensure absolute fairness to every competitor, it is essential that the procedure should be clearly defined and uniformly carried out at each centre. I have therefore to ask that the Conditions and Rules laid down in this Circular be strictly observed.

(1.) Competitors shall in all matters submit to the directions and rulings of the presiding officials.

(2.) No person other than the presiding officials and the competitors shall be allowed in the room between the opening and closing of an Examination.

(3.) The Examination Papers shall not be distributed earlier than five minutes before the time fixed for commencing the Examinations, and competitors shall not begin work until the actual time for commencement is announced by the officials.

(4.) Competitors shall not be allowed to leave the room, except in case of urgent necessity and accompanied by one of the officials, nor to converse or in any way communicate with each other, or with the superintending officials, during the progress of the Examination; nor to peruse, consult, or in any other way utilise any written, typed, or printed book, document, rules, Tariff, or other printed, written, or typed matter whatsoever, save and excepting only, that on the Examination in Subjects 10, 11, and 12, competitors may be allowed to use the Woollen Mills, Corn Mills, and Tanneries Tariffs, and the printed Warranties connected therewith. These Tariffs and Warranties must be provided by the competitors themselves, and a copy of the latter attached to the draft. It is the duty of the presiding officials to enforce the strict observance of this rule, any breach of which, if discovered, would result in the disqualification of the competitor.

(5.) If a competitor, after taking his seat for examination, be desirous of withdrawing from the competition, he shall immediately and silently leave the premises, first handing the Examination Papers to the presiding officials.

(6.) No extension of time can be allowed in connection with any subject under any circumstances.

(7.) Immediately on the expiration of the allotted time, the officials shall notify the fact to the competitors, who shall, without a moment's grace being allowed, cease work, every paper (whether finished, unfinished, or cancelled) being at once handed to the presiding officials. The competitor must write his name and address on the gummed slip provided for the purpose, and this must be attached to the left-hand top corner of the first sheet of the competitor's replies. The space for the number on the gummed slip must *not* be filled in by the competitor. The presiding officials in collecting the papers should see that each one has been addressed as directed. Each subject must be tied in a separate batch, and the whole returned to me by the same evening's post. A note signed by the presiding officials will accompany the Papers, certifying the observance of, or reporting any departure from, these Rules and Regulations.

(8.) When two or more subjects are being competed in at the same time, the competitors should be seated in separate groups, so as to facilitate the collection of Papers, and prevent annoyance to those remaining. Competitors in the subjects with the shorter time allowance shall at once withdraw on the expiration of the time allotted to their particular subject, after duly handing in their papers as directed.

(9.) All replies to questions should be as concise as possible.

(10.) Competitors must write on one side of the paper only, and must not write on the columned margin, which is required for the Examiners' notes. If the paper supplied to the competitors has no ruled margin, a space of one inch must be ruled off and kept clear on the left side of every sheet of paper used. Sheets must be paged and neatly pinned, so that they may be read without the pin or fastener being withdrawn. The printed Examination Forms may be retained by the competitors.

J. B. ROBERTS,
Hon. Secretary to the Examiners.

SUN BUILDINGS,
LEEDS.

EXAMINATION PAPERS.

SUBJECT No. 1—ELECTRICITY.

(Two hours allowed for this Paper.)

Ten questions only should be attempted. Questions 2, 4, 8, 11, and 17 must be attempted; the remaining five may be selected from any part of the paper.

QUESTIONS.

1. Distinguish between a direct and an alternating current.

*2. Define a dyne, watt, horse-power, joule, Board of Trade unit.

3. What is meant by the terms "ampere," "volt," "ohm"?

*4. How many horse-power is required to drive a current of 50 amperes through a resistance of $7\frac{1}{2}$ ohms?

5. What are the advantages of double-break over single-break switches? Why is a soft metal like copper generally preferred for the extremities of switch contacts? Without considering price, could you substitute a better material?

6. Sketch a form of incandescent lamp and holder suitable for factories where corroding vapours are present.

7. Describe, and illustrate by a sketch, any form of arc lamp you may be acquainted with. What special precautions have to be taken with arc lamps from a Fire Insurance point of view?

*8. You have to inspect an Insured's premises where the electrical supply has been changed over from 100 to 200 volts. What would particularly engage your attention?

9. Where should fuses be placed in an electric lighting installation, and why?

10. What is the operation of vulcanising? Why is vulcanised rubber so much used as an insulating material? Why is a layer of pure rubber sometimes interposed between a copper wire and the vulcanised rubber that surrounds it?

*11. What is a choking coil, and for what purposes is it employed?

12. What is a flux? What is the disadvantage of using zinc chloride?

13. A dynamo supplies current to 200 16-candle power 250-volt lamps, each taking ·2 amperes. The dynamo is 250 yards away from the main distribution board. If the resistance of a cubic inch of copper be taken as 0·66 microhms, what must be the cross section of the cable in order that the total drop between the dynamo and the point of distribution may not exceed 5 volts?

14. In a show window for the display of light fabric and other inflammable goods, where there is some danger of contact with incandescent lamp bulbs, what would you advise the proprietor to do, both in his own interest and in that of your Fire Office, if you found the lamps darkened with continuous use? Explain your reasons.

15. Give your reasons for affirming that electric incandescent lamps, properly installed in every respect, are the safest form of illuminant.

16. What danger is to be apprehended from an electrically driven motor car, carrying a battery of accumulators, when fully charged and ready for use, in a stable and straw store?

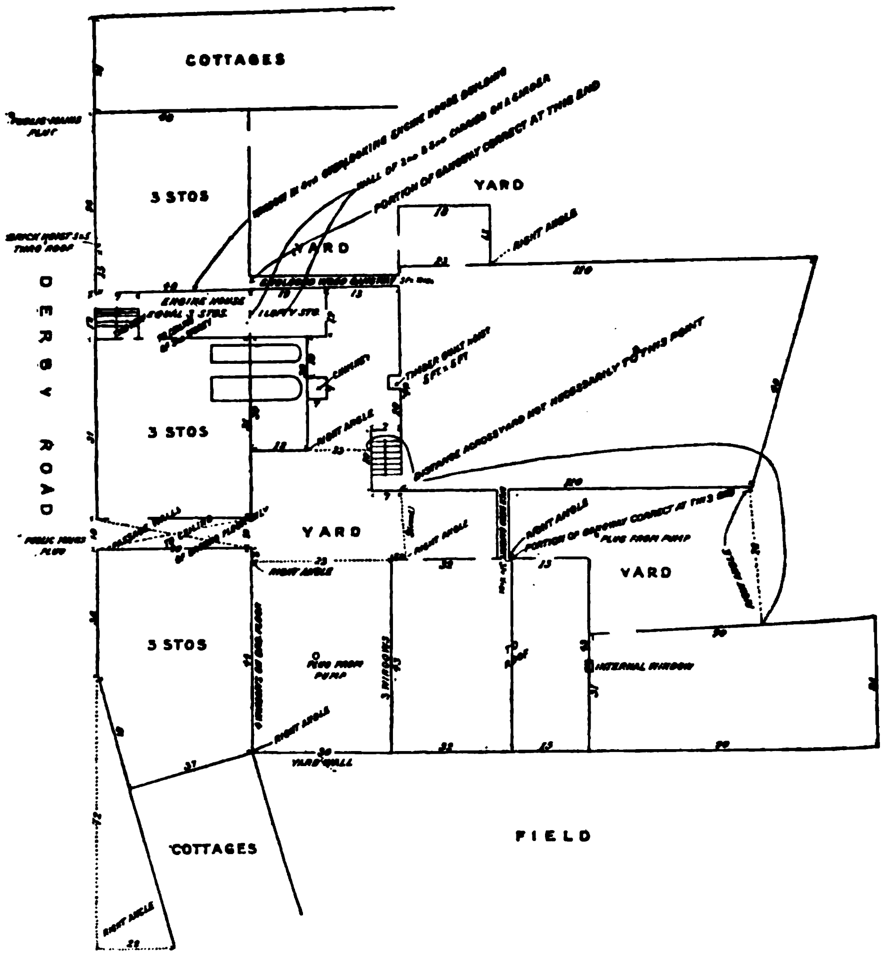
*17. What advantages and disadvantages have "competition" and "market price" upon the articles comprised in an electric installation? How do they affect fire hazard from an Insurance point of view?

SUBJECT No. 2.—PLAN DRAWING TO SCALE.

(*Two hours allowed for this Plan.*)

VICTORIA MILLS, DERBY ROAD, MANSFIELD.

The New Silk Spinning Co., Ltd., *Owners and Occupiers.*



Draw at a scale of 1 inch = 40 feet.

No windows need be shown except when specially mentioned.

Boilers, 30 ft. × 6 ft. 6 feet between boilers, and 6 feet from engine-house wall. Room for flue from outer wall adjoining chimney.

All measurements in feet.

SUBJECT No. 3—PROCESSES OF MANUFACTURE (WOOLLEN).

(One hour allowed for this Paper.)

QUESTIONS.

1. What constitutes the difference between "Wool" and "Worsted"?

2. A waste product called Noils is largely used in Woollen Mills. State (*a*) what this material consists of, and from what process it is derived; (*b*) if it comes under any Tariff charge for Material, and if so, what is the charge?

3. What is Mungo?

4. What is "Extract Wool," otherwise known as "Pulled Extract," or "Extract Waste"?

5. What is Shoddy?

6. Name a process by machinery in oiled material which should only be carried on outside the Mill, or, if within the Mill, in a fireproof compartment.

7. State what you know of this process, and why it is deemed specially hazardous.

8. Describe briefly the process and object of—
   (*a*) Scribbling and Carding.
   (*b*) Mule Spinning.
   (*c*) Twisting.

9. At what stage is oil applied to the raw material, and why is it so applied, when the yarn or cloth must afterwards be freed from every trace of oil?

10. Name two processes or methods of removing "burrs" from fleece wool.

11. Yarn is unwound from cops or bobbins into "hanks" on a reeling machine; before the Yarn can be woven it must be re-wound on to bobbins. What is the object of this apparently superfluous process of Reeling?

12. Can the twisting together of two threads of Yarn be done on a mule spinning frame as well as on a twisting frame?

13. What is (*a*) Yarn; (*b*) Warp; (*c*) Weft?

14. Name in proper sequence: (*a*) the processes in oiled Wool by machinery, from the Blending process to the stage where the material assumes the form of Yarn; (*b*) the processes by machinery from the Yarn to the woven fabric.

15. Lincey Rags (*i.e.*, Rags containing the tailor's linen or cotton thread, or from fabrics made with cotton warp) are pulled into Mungo on a rag machine. Where such Mungo is used (un-carbonised) in a Mill, what conclusion would you come to in regard to (*a*) the class of risk, and (*b*) the quality of manufacture?

16. A Blanket Mill, non-fireproof, is occupied for Willeying, Scribbling, Carding, and Spinning of blends consisting of pure Wool with a slight admixture of Shoddy, and dressed with the best non-chargeable oil. What opinion would you hold of the Mill as an Insurance risk? Give a reason for your opinion.

SUBJECT No. 4—PROCESSES OF MANUFACTURE (FLOUR MILLING).

(One hour allowed for this Paper.)

N.B.—Not more than ten questions to be answered.

QUESTIONS.

1. Resolve into a convenient analysis the main branches of a modern Milling Plant.

2. Describe the effect on grain under each system of grinding—(*a*) by stones, (*b*) by rollers.

3. What are the following: Middlings, Sharps, Semolina, Flour, Stive, Grist?

4. To what machines are fans attached, and what is the purpose served in each case?

5. Describe the action of a Middlings Purifier, and explain what is the difference between a Gravity Purifier and a Sieve Purifier.

6. What are the objections to an overcrowded Flour Mill?

7. Why is a machine used for scouring grain regarded as specially hazardous if it is other than horizontal?

8. Draw a sectional sketch of the head of a well-constructed Elevator.

9. Explain the difference between the old Silk Flour Dressing Machine and the modern Centrifugal Dresser.

10. What are (*a*) an Aspirator, (*b*) a Brush Machine.

11. At what stage are Scalpers used, and what purpose do they serve?

12. Which machines in a modern corn mill do you consider most liable to cause, or to spread, a fire?

SUBJECT No. 5—PROCESSES OF MANUFACTURE (LEATHER).

(One hour allowed for this Paper.)

Eight questions in Section I. and six questions in Section II. must be attempted.

QUESTIONS—SECTION I.

1. What is the object of Tanning Hides and Skins?

2. Name as many materials used in the process of Tanning as you may be acquainted with.

3. Name a particular constituent of these materials which gives to them their peculiar value for Tanning purposes.

4. What is the effect of this constituent property on the Hides and Skins of Animals?

5. State, briefly, the purpose of (*a*) Bate Pits, (*b*) Lime Pits, (*c* Tan Pits.

6. What is (*a*) Fleshing, (*b*) Striking?

7. At what stage in the various processes does the Hide or Skin become Leather?

8. What is the difference between a Disintegrator and an ordinary Grinding Mill, and for what purpose is each used?

9. Is there any, and if so what, special Fire Risk attached to the working of either or both of these Machines?

10. What precautions would you suggest (if any) in regard to either or both of these Machines?

Section II.

11. State as briefly as possible the object and method of Currying Leather?

12. What Oils, or other fatty substances, are used in the process?

13. What is "Lamp Black" or "Vegetable Black," and is there any special Fire Risk connected with its use or storage?

14. Would you suggest any precaution in regard to the use or storage of this substance?

15. What is (*a*) Shaving, (*b*) Stuffing, (*c*) Splitting?

16. Name two methods of making Dubbin, and suggest a means of minimising the Fire Risk from this process.

17. In what order of merit, from an Insurance standpoint, would you place the following risks:—

   (*a*) A "Wet Tannery," where no Currying or subsequent process is carried on.
   (*b*) A Tannery, where all processes up to and including Currying are performed.
   (*c*) A Leather Works, where no Tanning is done, but where the Currying, Dressing, Enamelling, and Japanning of Fancy Leathers is carried on.

18. Mention four features of Fire hazard in Tanners' and Curriers' risks.

SUBJECT No. 6—PROCESSES OF MANUFACTURE (MACHINE MAKING).

(One hour allowed for this Paper.)

Questions.

1. State the principal elements of fire risk in connection with the process of Machine Making.

2. What is a Lathe? a Drilling Machine? a Planing Machine?

3. What is lamp black?

   (*a*) For what purpose is it used in Machine Making?
   (*b*) Describe the dangers which arise from its storage in buildings, and how they may be minimised.

4. State briefly the elements of fire risk in regard to each of the following, and what precautions you would suggest to minimise such risk:—

(*a*) Pattern making.
(*b*) Use of cleaning waste.
(*c*) Tinners' stoves and stoves for warmth.
(*d*) Storage of wood patterns and models.
(*e*) Storage of oils and cleaning waste.
(*f*) Boiler house.

5. Describe the principal stages in the process of japanning of metal.

(*a*) State approximately the maximum temperature to which a stove is heated for drying japanned metal.
(*b*) What do you consider are the principal elements of fire risk in the process of japanning?

6. Define the general distinction between the trade of Engineering and that of Machine Making.

SUBJECT No. 7—WOOLLEN MILLS TARIFF.

(One hour allowed. 140 Marks required to Pass, and 170 for Honours.)

N.B.—Candidates may only answer four of the questions numbered 6, 7, 8, 9, 10, and 11.

QUESTIONS.

1. Give a list of the Mills and Buildings to which this Tariff applies, as specified in the preamble.

2. Write out as fully as possible the Tariff clause explaining the term "Shed."

3. Under what circumstances would you allow, without extra charge, in a non-fireproof Mill occupied for Scribbling, Carding, Spinning, Weaving, Fulling, and Milling—

(*a*) Floor openings.
(*b*) More than one tenant.
(*c*) A common fire-place.
(*d*) Night work.
(*e*) Willeying.
(*f*) Suspended sheets.
(*g*) Arc lamps.

4. In an Annual Policy 25 per cent. of added cotton is allowed. What further extra would you charge for the use of 60 per cent. of added cotton for four months?

5. What are the additional rates applicable to a non-fireproof Carding Mill for—

(*a*) Heating by high pressure hot water apparatus?
(*b*) Lighting by approved incandescent gas lamps?

(c) Boiler in non-fireproof room, communicating directly with the Mill, and Woollen Yarn dried in same compartment as the boiler?
(d) Garnetting Insured's own waste containing cotton?
(e) Unscoured camels' hair bags?
(f) Cotton drying by steam heat?

6. A building of three storeys is occupied by two tenants; one for Weaving in plain looms, using cotton warps, and the other for Milling, Fulling, and Wet Raising. Night work is allowed, approved incandescent gas lamps are used, and there are wooden stairs through the floors. What is the Tariff rate?

7. Give in detail the rate for a Shed occupied for Rag Grinding on one machine, and also for Willeying Mungo (pulled from unseamed rags) and Cotton (exceeding 50 per cent.). Black oil (50 per cent. saponifiable) used.

8. Give in detail the rate for a non-fireproof Mill of five storeys in height, in the sole tenure of a Manufacturer of Imitation Astrachans, for Scribbling, Carding, and Spinning, using wool, hair, mungo, and shoddy (free from vegetable fibre), and manufactured oil containing 40 per cent. of unsaponifiable matter. No other extras.

9. A non-fireproof Mill of three storeys in height is in sole tenure of a Manufacturer of Meltons, for Scribbling, Carding, and Spinning, using wool, shoddy (free from vegetable fibre), and manufactured oil (75 per cent. saponifiable and flash point 350° Fahrenheit). No other extras but Rag Grinding is done on the premises, and the material pulled with black oil (50 per cent. saponifiable). What rate is chargeable?

10. At a distance of 8 feet from a Carding Shed (mungo, free from vegetable fibre used, but no other extras therein) is a Boiler House (no openings within 10 feet of openings in shed) in which no drying is done. Give the rate for each building.

11. What is the rate for a two-storey building, in single tenure, occupied for Spinning Woollen Yarn and for Weaving in plain looms, using cotton warps. Three Jacquard looms for Pattern Weaving (lights in order), and two trap doors through the floor.

12. What are the rates for the following silent buildings:—
(a) Carding Mill?
(b) Willeying Shed?
(c) Spinning Mill?
(d) Weaving Shed?
(e) Boiler house (having drying room over boiler)?

13. What rate would you charge, and what conditions would you apply to an Insurance in one sum on the Building of a fireproof Mill of four storeys, in single tenure, as follows:—
Ground floor—Cloth Milling and Raising.
Second floor—Carding of pure coloured wool dressed with olive oil.

Third floor—Spinning and Twisting mixtures of wool and cotton.

Fourth floor—Weaving in Jacquard looms, using cotton warps.

14. State briefly the rule relative to the rating of communicating buildings.

15. Name the processes rateable under Section VII. of the Tariff.

SUBJECT No. 8—TARIFFS (CORN MILLS, No. 2—ENGLAND).

(*One hour allowed for this Paper.*)

QUESTIONS.

1. What Corn Mills are exempted from the operation of this Tariff, and how are such Mills provided for?
2. State the rule with reference to (*a*) Rice Mills, (*b*) Provender Mills.
3. What stones, discs, and rollers are to be counted in a Mill?
4. What is the minimum requirement as to those spouts which are not to be deemed communications?
5. State the requirements, charges, and allowances relating to artificial lighting.
6. Under what circumstances are portable lamps allowed to be used?
7. State fully the charges for a Steam Boiler, &c., within the Mill.
8. State the charges as to Elevators.
9. What is the difference between the charges for Shelling Oats and for Grinding Shells of Oats?
10. State the complete charges for Scouring, Brushing, or Cleansing Grain within the Mill.
11. What machines are specially named as coming under these charges?
12. What is a non-chargeable Middlings Purifier?
13. Show, in detail, the rate (including normal) for a Mill of 6 storeys, containing 500 inches roller contact, and 5 Double Purifiers (chargeable).
14. How do you arrive at the length of roller contact in a Mill?
15. What are the requirements as to a Stive Room which may be allowed without extra charge on the Mill?
16. What fans are allowed without charge?
17. Under what conditions may a Granary adjoining a Mill be taken at three-fourths the Mill rate?
18. Show, in detail, the rating for Mills A and B, which adjoin, but are properly separated.

Mill A, of 7 storeys, contains 6 pairs stones, 6 sets of rollers, each set containing 4 rollers of 30 inches in length; Oat Grinding.

Mill B, of 5 storeys, contains 3 sets of rollers, each set having 4 rollers of 40 inches, and 2 sets each having 2 rollers of 20 inches; upright main driving shaft; Smut House, having a window within 20 feet.

19. What extinguishing appliances are required in order to earn (*a*) 7½ per cent. discount; (*b*) 10 per cent. discount?

20. State, precisely, the wording for (*a*) Millwrights' Work, &c., (*b*) Stock-in-Trade, &c., with special Tariff Notes relating thereto.

SUBJECT No. 8—TARIFFS (CORN MILLS TARIFF—SCOTLAND).

Questions.

1. What processes bring a Mill under the denomination of a Corn Mill?

2. State the charges for Drying.

3. State the rule as to what stones, or sets of rollers, in a Mill are chargeable.

4. What grinding machines are specified in the Tariff; how is each to be reckoned, relatively to a pair of stones?

5. Under what circumstances is a further charge applied to stones?

6. What is the charge for (*a*) a Disintegrator, (*b*) a Pease Girdle, in the Mill?

7. What is the charge for (*a*) Grinding and Shelling Oats, (*b*) Grinding Shells of Oats and Shells of other grain?

8. What is the charge on the Mill for a Smut House, which, being outside the Mill, communicates therewith only (*a*) by double iron doors, (*b*) by single iron doors, (*c*) openly?

9. How must a Smut House be arranged so as to avoid any charge on the Mill?

10. Quote the N.B. in the Tariff as to Machines for Separating, &c.

11. What Fans in a Mill should be reckoned? What is the charge for ten Fans?

12. What is the charge on the Mill, if any, for a Stive Room communicating with the Mill, (*a*) if used in connection with stones, (*b*) if not so used?

13. What is the charge on the Mill for (*a*) an Exhaust Room, not in connection with stones, and a machine for collecting dust, (*b*) an Exhaust Room in connection with stones and an apparatus for collecting stive?

14. What is the minimum rate for a Smut House?

15. Rate, in detail, a Mill of 5 storeys, containing 6 pairs of stones and 10 sets of rollers (4 pairs of stones not being bedded in metal); oats ground; fireproof Boiler House within the Mill, and communicating by single iron door only.

16. Rate, in detail, the two Mills, A and B, which adjoin and communicate only by double iron doors, the party walls being carried through the roof.

Mill A, of 6 storeys, contains 4 pairs of stones and 12 sets of rollers; Oat Grinding and Shelling.

Mill B, of 4 storeys, contains 10 sets of rollers, worked by night; fireproof Smut House within the Mill, communicating by double metal-covered doors only.

17. A miller wishes to know how he should arrange the Mill, Smut House, Stive Room, Boiler House, and Granary, which he intends to build, so as to secure the most favourable rate; but he stipulates that the buildings must adjoin, and that he must have reasonable facilities for communication between them, both for persons and material. Say what you would suggest, and illustrate by a rough ground plan.

18. State the rules as to communications.

19. What extinguishing appliances are required in order to earn a discount of 7½ per cent.?

20. Write out the Schedule of Specification.

SUBJECT No. 8—CORN MILLS TARIFF (IRELAND).

Questions.

1. What does the Tariff term "Corn Mills" include?

2. Under what circumstances may a building used for the production of food for cattle be rated at 5s. per cent.?

3. What Insurances are subject to Average?

4. What additional rate applies to a Flour Mill for construction of iron upon wooden framework?

5. In fixing the extra for height, how is the measurement to be taken of a chargeable basement which has no ceiling?

6. Define what is comprised by a set of rollers.

7. What is the equivalent for (*a*) an "Albion Grinding Mill," and (*b*) an "Askham's Patent Tiger Mill"?

8. State the methods suggested for drying, otherwise than by kiln, and the charges.

9. State the complete charges for Scouring, Brushing, or Cleansing grain within the Mill.

10. What machines are specially named as coming under these charges?

11. What is the extra charge for (1) a non-textile Dust Collector, and for (2) a Disintegrator?

12. Define the communications permissible between a Flour Mill and Exhaust Room outside.

13. What is the minimum rate for a Stive Room?

14. What is the essential provision for obtaining any percentage for discount for Fire Extinguishing Appliances?

15. What Extinguishing Appliances are required in order to secure a discount of 7½ per cent.?

16. State the warranty imperative with allowance for automatic sprinklers?

17. State the prime condition upon which the allowance for electric lighting is based, and the method for calculation.

18. State the rate (with particulars) for a Flour Mill answering to the following description:—

> Worked by steam; 6 storeys and attic; nightwork; 19 sets rollers; boiler-house adjoining, but not communicating; screen-house outside, communicating only by double fireproof doors; and non-textile dust collector on top floor.

19. Fix the rate (with particulars) for a Corn Mill answering to the following description:—

> Worked by steam; 5 storeys in height; 15 pairs stones, of which 1 pair used for sole purpose of shelling oats; and stive of canvas construction.

20. Assuming that the above-mentioned Mills are separated by an imperfect wall, not carried through the roof, in which are 5 doorways, state the premium for an Insurance of £10,000 in equal proportions on the two said Mills, 10 per cent. being allowed for electric lighting, and 10 per cent. for extinguishing appliances:—

(*a*) As they stand.

(*b*) With the wall carried through the roof and perfected.

(*c*) With the wall carried through the roof and perfected, but allowing two communications by double fireproof doors.

SUBJECT No. 9—TANNERIES' TARIFF.

Questions.

1. To what trades does the Tanneries' Tariff apply?

2. Give particulars of the three Warranties applicable to all Insurances under the Tariff.

3. State the charge for height, and say under what circumstances a Warehouse is exempt from such charge.

4. Detail the drying or conditioning provisions of the Tariff.

5. If grinding of tanning materials is done by Disintegrator, what extra rate is chargeable?

6. What are the principal divisions set out in the form of Specification?

7. Under what conditions may Naphtha or Benzine be used without additional charge?

8. Quote the rule as to non-establishment of Agencies.

9. What are the current provisions in respect of tan and lime pits?

10. At a certain Tannery, a building two storeys in height, occupied as a bark and valonia store and bark-grinding house, in which grinding is done *other* than by Disintegrator, is in existence. All Warranties, except those as to height and grinding, are applicable. What is the rate?

11. What are the japanning and enamelling charges?

12. What items of "Specification No. 1" are subject to Average?

SUBJECT No. 10—POLICY DRAFTING (WOOLLEN MILLS).

(*For this Examination one hour and a half is allowed, and the use of Tariffs is permitted.*)

N.B.—Printed Warranties must be used and attached to the Draft.

Description.

Jubilee Mills, situate Queen Street, Leeds; owners and occupiers, Messrs. Black & Brown, Woollen Manufacturers.

1. Four Storeys. 1st (fireproof and divided by 18-in. brick walls into three compartments, each having external entrance only):—(*a*) Engine room, (*b*) willey room (1 shaker, 1 teazer), (*c*) milling, scouring, and raising; 2nd and 3rd (ordinary construction), Scribbling, carding, condensing, and mule spinning; 4th (ordinary construction), Mule spinning and twisting. External stone staircase from ground to 4th, and approved Incandescent Gas Lamps used in three uppermost floors.

2. Two Storeys (detached 12 ft. from No. 1). 1st, Boiler room and Firing-place (no drying); 2nd (the floor of perforated iron plates on iron joists), Woollen yarn drying on poles. The roof formed by an iron water cistern.

3. Three Storeys (detached 20 ft. from Nos. 1 and 2). 1st, Offices, press shop (power used for pumps and the press-plate oven heated by steam), and cloth-finishing room; 2nd, Burling, mending, pattern-weaving (in 2 hand-looms), and piece warehouse; 3rd, Piece warehouse. Wooden stairs and hoist through all floors.

4. One Storey. Winding, warping, beaming and weaving (plain looms and cotton warps); communicating with No. 3.

N.B.—Cubical contents of Nos. 3 and 4 = 300,000 feet.

Materials.—Wool, bought worsted waste, shoddy (containing vegetable fibre), and cotton (not exceeding 50 per cent.).

Oil.—Manufactured Oil, containing 60 per cent. saponifiable.

Fire Extinguishing Appliances.—Stationary Fire Engine, with hydrants attached; hose and buckets to scale throughout.

All S. or B. and S. No Tariff extra rates except those mentioned.

RATES.

No. 1: 1st, (*a*) 5/-; (*b*) Normal 31/6, Material 10/-, Cotton 7/6, Oil 5/- = 54/-; (*c*) 4/-; 2nd, 3rd, and 4th, Normal 10/-, Material 10/-, Cotton 7/6, Oil 5/-, Willey 4/-, Lamps 3/- = 39/6.

No. 2: 15/-.
No. 3: 5/-, rate for No. 4.
No. 4: 5/- (Normal 4/-, Cotton Warps 1/-).
Discount 12½ per cent. for Fire Extinguishing Appliances.

A Proposal is received as follows:—

	Building.	Shafting.	Machinery.	Piping.	Stock.	Total.
	£	£	£	£	£	£
Engine Room .	200	---	500 (Engine)	20	—	720
Willey Room .	150	20	125	10	50	355
Scouring Room .	400	80	500	20	500	1,500
Three Top Floors	3,000	400	6,000	100	1,000	10,500
Boiler House .	300	50 (Cistern on Roof.)	200 (Boiler)	25	100	675
Warehouse .	1,000	30	200	20	3,000	4,250
Shed . .	1,000	250	2,000	50	1,800	
					300 (Cards and Patterns.)	5,400
						£23,400

Draft a Policy from the foregoing particulars and calculate the Annual Premium.

SUBJECT No. 11—POLICY DRAFTING (CORN MILLS—ENGLAND AND WALES, SCOTLAND, AND IRELAND).

(*For this Examination one hour and a half is allowed, and use of Tariffs permitted.*)

N.B.—Printed Warranties must be used and attached to the Draft.

DESCRIPTION.

Union Mills, situate {Sheffield (E. & W.) / Perth (S.) / Cork (I.)}; owned and occupied by John Brown, Corn Miller.

1. Five Storeys and Attic. 1st, Part Water-wheel place, remainder contains main shafting and elevator bottoms; 2nd, Stone room, containing 4 pairs stones, 1 pair malt rolls (24-in.), and 1 bean splitter (two 8-in. rolls working against a plate), also 2 independent fans; 3rd, Roller room, containing 12 sets rollers (688-in. contact); 4th, Middlings purifiers (dustless); 5th, Scalpers, centrifugals, and flour mixers; Attic, Wire dressing machines, elevator tops, and grain store.

1A. Stone Staircase, giving entrance to Mill on each floor, and having sprinkler tank at top and main valves and gauges in compartment at foot.

2. Five Storeys. Grain and flour warehouse, communicating with No. 1 on 1st and 5th floors by double iron doors.

3. Three Storeys and Attic. 1st (fireproof and having external entrance only), Engine room, also contains dynamo and a small independent steam engine for working same; 2nd and 3rd, Screen rooms, communicating with No. 1 by double iron doors; Attic, Dust room in connection with screens.

4. One Storey. Boiler house and Firing-place, adjoining and communicating with 1st of No. 3.

N.B.—Nos. 2 and 3 are each separated from No. 1 by party walls 18 inches thick, carried through and 30 inches above roofs.

F.E.A.—Fire plugs, hose, buckets, and in Nos. 1 and 3, "Grinnell" sprinklers supplied by 4-in. connections from (1st) town's main and (2nd) tank (5000 gallons).

All S. or B. and S., in sole tenure of John Brown; lighted by incandescent electric light and worked by steam and water power (occasionally at night). No Tariff extra rates except those mentioned.

RATES.

Nos. 1 and 1A, also No. 3 (upper floors)—

	(E. & W.)	(S.)	(I.)
Normal ...	6/-	10/6	10/6
Stones and Rolls	15/-	13/-	13/-
Height ...	4/6	4/-	4/-
Night Work ...	—	2/6	1/-
Screen Room ...	2/-	5/-	2/-
Fans	2/-	5/-	—
Stive Room ...	—	—	2/-
	29/6	40/-	32/6

No. 2—

(E. & W.) ...	22/1½	¾ of No. 1.
(S.)	40/-	No. 1 rate.
(I.)	16/3	½ of No. 1.

No. 3 (1st floor) and No. 4, 10/6.

F.E.A. Discount—
10 per cent. on 1st of 3 and 4,
30 per cent. on remainder.

Electric Light Discount—
10 per cent.

A Proposal is received as follows:—

	No. 1.	No. 1A.	No. 2.	No. 3. First floor.	No. 3. Upper floors.	No. 4.	Total.
	£	£	£	£	£	£	£
Building	1,500	200 (Including tank on roof.)	1,000	200	500	150	3,550
Steam, Water, and Gas Pipes	70	—	50	—	30	—	150
Water-wheel	200	—	—	—	—	—	200
Steam Engines ...	—	—	—	400	—	—	400
Steam Boilers... ...	—	—	—	—	—	100	100
Machinery and Shafting	4,000	—	—	—	800	—	4,800
Stock	500	—	2,500	—	250	—	3,250
Stock on Commission	100	—	1,000	—	50	—	1,150
Sprinkler and Electric Light Installations...	450	150	—	100	150	—	850
	£6,820	350	4,550	700	1,780	250	14,450

Draft a Policy and calculate the Annual Premium.

SUBJECT No. 12—POLICY DRAFTING (TANNERIES).

(*For this Examination one hour and a half is allowed, and use of the Tariff permitted.*)

N.B.—Printed Warranties must be used and attached to the Draft.

Description.

Beck Tannery, situate Fulford, York; owned and occupied by James White & Sons, Tanners and Curriers.

1. Four Storeys. 1st, Part contains Tan Pits, remainder as Store for tanning materials (a bark mill and a small auxiliary steam engine therein), and for Leather Drying by steam pipes; 2nd, Rounding, Shaving, Stuffing, and Whitening (dubbin made in steam-heated jacket pans); 3rd, Blacking, Sizing, Glossing, and for Leather Drying by steam pipes; 4th (louvre-boarded windows), Leather Drying by steam pipes and natural heat.

2. One Storey. Tan and lime pits shed, and for fulling and tumbling; communicating freely with Nos. 1 and 3.

3. Two Storeys. Warehouse for rough and finished leather.

4. One Storey. Engine house; adjoining but having no communication with No. 1.

5. Two Storeys. 1st, Boiler room and Firing-place, the boiler covered with 4½-in. brickwork; 2nd (perforated tile floor) Drying room for "spetches." Communicating with No. 4.

6. Three Storeys (detached 60 yards from above). 1st, Offices—common fire-places; 2nd and 3rd, Warehouse for finished leather.

Bark stocked in open.

All S. or B. and S. or T., lighted with coal gas, heated by steam (common fires in offices), and worked by steam power. No Tariff extras except those mentioned.

RATES.

Nos. 1 and 2: Normal, 5/.; Construction, 1/-; Height, 1/6; Currying, 2/6; Dubbin, 1/-; Bark Grinding, 2/-; = 13/- (Leather in Pits, 6/6.)
No. 3: 5/-
No. 4: 6/-

No. 5: Normal, 5/-; Height, 6d. Drying, 6d.; = 6/-
No. 6: 2/6.
Bark in open, 5/-.
Fire-plugs and hose, discount 5 per cent.

A Proposal is received as follows:—

	Nos. 1 and 2.	No. 3.	No. 4.	No. 5.	No. 6.	In Open.	Total
	£	£	£	£	£	£	£
Building	3,000	500	100	150	600	—	4,350
Machinery	2,000	—	—	—	—	—	2,000
Steam Engine	100	—	400	—	—	—	500
Steam Boilers	—	—	—	100	—	—	100
Stock-in-Trade	4,000	2,000	—	25	2,500	—	8,525
Do. (in trust)... ...	1,000	500	—	—	1,000	—	2,500
Leather in Pits	800	—	—	—	—	—	800
Liquor in Pits	600	—	—	—	—	—	600
Trade and Office Furniture and Fittings	—	100	—	—	200	—	300
Bark...	125	—	—	—	—	200	325
							£20,000

Draft a Policy and calculate the Annual Premium.

SUBJECT No. 13—LAW OF FIRE INSURANCE.

(Policy Conditions, Average, Insurable Interest, Loss Apportionments.)

(*Time: Two hours.*)

QUESTIONS.

1. What is the construction to be placed upon the term "fire" in the contract against "loss or damage by fire"?

2. Give a list of specified property which, under the conditions of the Policy, is not covered by the insurance. State also the forms of loss and damage from which the Companies usually claim exemption under same condition.

3. State the respective rights of Insurers and Insured in the salvage from a fire:—

   (*a*) When the Policy contains no Condition of Average.

   (*b*) When the Policy is subject to Average.

4. Define four of the following terms:—

   Arson, Assignee, Bailee, Mortgagor, Novation, Rent, Subrogation, Trustee.

5. What are the restrictions to an assignment of a Fire Policy? and state the grounds upon which these are founded.

6. Give as many examples as you can of Insurable Interest.

7. Under what circumstances was the Condition of Average made compulsory by statute? and state the exceptions, if any.

8. Define the effect of each of the two Conditions of Average.

9. Give a short resumé of the principles laid down in the case, "Glasgow Provident Insurance Society *v.* The Westminster Fire Insurance Company," as to the extent of liability of Insurers to postponed mortgagees.

10. An Insured having his stock destroyed by fire, claims a total loss and intimates that he abandons the remains to the Company, and threatens to enter an action at law for recovery of the amount claimed if not immediately paid. Write a letter in reply.

11. Apportion the following loss:—

    On a Grain Merchant's stock-in-trade £1000, there being £200 of this for goods held in trust.

    Office A insures £750 on stock-in-trade, the property of the Insured only.

    Office B insures £750 on stock-in-trade, the Insured's own or in trust.

    (Fractions of £1 may be discarded.)

12. Policy 1 for £1000 covers goods in Warehouse X; Policy 2 for £1000 covers goods in Y; Policy 3 covers goods for £4000 in X and Y. The value of goods in X and Y is £1000 and £2000 respectively. The loss in Warehouse X is £500, and the loss in Warehouse Y is £750. Show the amount to be paid by each policy, Policy 3 being subject to average.

SUBJECT No. 14—EMPLOYERS' LIABILITY INSURANCE.

(Two hours allowed for this Paper.)

Note for Candidate.—Questions 1 or 2 must be attempted.

QUESTIONS.

1. Give a brief summary of the Law relating to Compensation for Accidents to Workmen in any two Continental countries.

2. A and B are employers of labour, engaged under separate contracts upon the erection of a building over 30 feet in height. One of the workmen in the employ of A is injured, through a workman in the employ of B dropping a tool upon him from a scaffold erected at the second floor height. State if liability to pay compensation to the injured workman for this accident rests upon A or B, and, if so, under what statute.

3. State, in your own words, the meaning of (*a*) Workman, (*b*) Employer, (*c*) Undertaker,—as used in the Workmen's Compensation Act, 1897, and the Employers' Liability Act, 1880.

4. (*a*) Under what circumstances is an Employer liable to a Workman under Common Law? (*b*) Describe an imaginary case.

5. Draft the necessary ruling and head lines for a book or books in which to register claims under the Workmen's Compensation Act, 1897.

6. Write a letter, answering an imaginary policy-holder who has enquired a reason for the exclusion by the Workmen's Compensation Act, 1897, of compensation for the first fortnight of disablement.

7. In the case of a fatal accident under the Workmen's Compensation Act, 1897, what documents should a widow be called upon to produce in support of a claim on behalf of herself and family?

8. In view of legal decisions, indicate briefly what amendments you would suggest to the Workmen's Compensation Act, 1897, so as to make it accord with the intention of the Government.

SUBJECT No. 15—CORRESPONDENCE (FIRE BRANCH).

(One hour allowed for this Paper.)

1. A lady, whose furniture in a private dwelling-house is insured for £1000 at 2s. per cent., due at Lady Day, writes upon the 1st July:—

> "Dear Sir,—Please take notice that I am about to leave for the Continent, and intend to place portion of my furniture in Peacock's Warehouse, Gosta Green, and the remaining portion with a friend on the Hagley Road.

"My plate, and a portion of my jewellery, will be deposited with Lloyd's Bank, Colmore Row.

"Please let me know if my present Policy will hold these secured."

Write a reply.

Assuming you get the information asked for, draft the necessary Endorsement.

Assume the rate for Peacock's Warehouse at 5s. per cent.

2. A Carpenter and Builder writes:—

"I wish to insure my workshop and yard in your office. Please say what the rate will be."

Write reply, asking the necessary questions.

3. Write a suitable reply to either of the following letters received from Agents:—

"Norton, 4th January 1900.

"Gentlemen,—I regret to have to inform you of a serious fire at the property insured by Policy No. 501,807, which insures building and contents of Messrs. Smith & Jones' Corn Mill here.

"I visited the place this morning, and find that the Smut House and Cleaning Mill are gutted, and very serious water and smoke damage has been done to the main Corn Mill and Warehouse.

"The premium due at Christmas has not been paid, and, on its being tendered to me when I called at the Mill to-day, I declined to accept it until I had your instructions in the matter.—Yours truly,

"Y. Z., *Agent.*"

OR,

4. "Norton, 4th January 1900.

"Gentlemen,—Please note that I have granted protection for £20,000 on Messrs. Smith & Jones' Steam Saw Mills here, and have arranged for an inspection to be made by your Surveyor this day week.—Yours truly,

"Y. Z., *Agent.*"

SUBJECT No. 16—CORRESPONDENCE (LIFE BRANCH).

(One hour allowed for this Paper.)

1. An Agent sends up a set of papers in connection with a new assurance. Proposer says he wants "an assurance for ten years," but does not specify further whether it is a Term Policy or an Endowment Assurance he requires. Proposer states that his father died at age 53 from "general break-up," and that his mother died at age 38 from "neglected cold." It is desired to ascertain if the father was of intemperate habits, and if cause of the mother's death was not in reality consumption. The cause

of death of a brother at age 22 is not stated. One of the friends says proposer is "fairly temperate." Acknowledge the Agent's letter, dealing with the points calling for attention.

2. An Agent remits for his Monthly Account, having omitted to sign the latter. He takes credit for a medical fee he paid, but does not send the voucher. He deducts commission at rate of 5 per cent. on a premium instead of $2\frac{1}{2}$ per cent., and he erroneously charges commission on interest collected by him. In consequence of these errors a balance of 25s. is due by him on foot of his Account. Acknowledge the Account.

3. A Policy Holder has an Endowment Assurance Policy for £1000, payable at age 65 or previous death. He enquires:—

> (*i.*) The surrender value of the Policy.
> (*ii.*) The annual premium if the Policy be changed into one payable at death only.
> (*iii.*) The annual premium if the Assurance be changed to £250, payable at age 55 or previous death.

Reply to his letter given that:—

> (*i.*) Surrender value is £110.
> (*ii.*) The annual premium for change to Whole-life Policy is £13; a medical examination at assured's expense being necessary before this change can be effected.
> (*iii.*) The annual premium for this change, £15 10s.

SUBJECT No. 17—MATHEMATICS.

(Time allowed: Three hours.)

QUESTIONS.

1. Simplify:—

$$\frac{(\frac{2}{5} - \frac{1}{4})(\cdot\dot{4} - \cdot 3)}{\frac{3}{5} \text{ of } 2\cdot 2. \div \cdot\dot{5}}$$

2. A watch gains 5 minutes in 60 hours; if it be set right at noon on Sunday, find the true time when it indicates 4 p.m. on the following Wednesday.

3. At what rate per cent. (simple interest) will a sum of money amount to £7786 16s. at the end of the first year, and to £8013 12s. at the end of the second year?

4. A person invested a certain sum in the 3 per cents. at $77\frac{5}{8}$, on the price rising to $82\frac{1}{2}$ he sold out, and with the proceeds bought 5 per cent. stock at 96, by which he increases his income by £41 10s. Find the sum originally invested.

5. Define Greatest Common Measure and Least Common Multiple. Show that every Common Multiple of two algebraical expressions is a multiple of their Least Common Multiple.

6. Determine three numbers such that their sum is 9; the sum of the first, twice the second, and three times the third, 22; and the sum of the first, four times the second, and nine times the third, 58.

7. Solve the equations:--

(i.) $x = 1 + \frac{1}{x}$

(ii.) $x^4+x^2y^2+y^4=133$
$x^2+xy+y^2=7$

8. Prove that the sum of the $(p+q)^{th}$ and $(p-q)^{th}$ terms of an Arithmetical Progression is equal to twice the p^{th} term.

The sum of $2n$ terms of a Geometrical Progression, whose first term is a and common ratio r, is equal to the sum of n of a Geometrical Progression whose first term is b and common ratio r^2. Prove that b is equal to the sum of the first two terms of the first series.

9. Define Permutations and Combinations.

For what value of r will the number of Combinations of n things taken r at a time be greatest?

10. How many different arrangements may be made of the letters in the word *Federation* taken all together?

In how many ways can n things be given to p persons when there is no restriction as to the number of things each may receive?

11. Expand $(1-x^2)^{\frac{1}{2}}$ to four terms, and find the greatest term in the expansion of $(x+a)^n$.

12. Define a logarithm, and explain the use of logarithms.

Show that $\log._b x = \frac{\log._a x}{\log._a b}$

13. Given log. $2=\cdot3010300$, log. $3=\cdot4771213$, obtain logs. of 675 and $\cdot00216$; and find x from the equation $2^x+2^{x-1}=10$.

14. The population of a country is now one million, and it is increasing at the rate of 2 per cent. per annum. Find when it will be doubled.

Given log. $2=\cdot30103$
log. $3=\cdot47712$
log. $17=1\cdot23045$

[The following question is optional. Double marks will be allowed for a correct solution.]

15. Bronze contains 91 per cent. of copper, 6 of zinc, and 3 of tin. A mass of bell-metal (consisting of copper and tin only) and bronze fused together, is found to contain 88 per cent. of copper, 4·875 of zinc, and 7·125 of tin. Find the proportion of copper and tin in bell-metal.

SUBJECT No. 18—LIFE ASSURANCE AND LIFE OFFICE WORK.

(Three hours allowed for this Paper.)

The maximum number of questions which Students are to answer is 14. They may make their own selection, provided that Two questions at least in each Section be dealt with.

Mortality Tables and Construction of Premiums—

1. State what you know of the English Life Table No. III.; and for what purpose is it specially suitable?

2. The value of the Annuity due of £1, at age x and at 3 per cent. interest, is 13·015. Calculate the single and annual premiums at age x for an Assurance payable six months after death.

3. Explain how the "expectation of life" is calculated.

4. At age 60, the number living is 58,866, and at age 61 the number is 57,119. What is the probability (1) of a life aged 60 surviving a year; (2) dying in a year; (3) of two lives both aged 60 dying in a year?

Valuations and Reserves—

5. Describe the principal sources from which the surplus of a Life Office arises.

6. State a few of the methods of allocating Bonus adopted by Life Assurance Offices. State which of these is, broadly considered, in your opinion, the most equitable. Give your reasons, and mention under what special circumstances other methods of allotment would be sound.

7. Give a table comparing the amounts of a Policy for £1000, increased by simple reversionary bonus at the rate of 1 per cent. per annum, for five quinquennial periods, with one increased by compound reversionary bonus at the same rate and for the same periods.

8. Explain how you would value at an investigation the Policies (1) on which no farther premiums are payable; and (2) those by a definite number of premiums, some of which are still payable.

Law of Life Assurance—

9. What are the rates of Stamp Duty on (1) a Life Assurance Policy, (2) an Annuity Bond, (3) a Deed to secure a Loan, (4) an Indemnity?

10. What are the principal provisions of the "Married Women's Property Act, 1882," as regards Policies of Life Assurance?

11. What is an "Equitable Mortgage"?

12. State what you know of the law regarding presumption of death in the case of persons who have disappeared.

Conditions of Assurance—

13. Frame the Endorsement on a Policy, altering it from an Assurance payable at death to one payable ten years from the date of the alteration, or at death if sooner, taking imaginary names, dates, and figures to suit the case.

14. What are the usual practices of Offices as to charging extra premiums for naval, seafaring, and military risks? What are the other special risks that are met with in Life Assurance business?

15. Write a letter to a newly-appointed Agent explaining to him (1) the special advantages of an imaginary Office; and (2) instructing him how he should begin to get new business.

16. State the points to be kept in view in judging of the eligibility of a life for Assurance.

Payment of Claims—

17. When a Policy becomes a claim either by death or survivance, what forms have to be gone through before the sum assured can be paid?

18. What form of procedure would you adopt in arranging for payment of the sum assured under a Policy which has been lost?

19. Mention the different methods adopted for idemnifying the Office when the age of the life assured has been understated. Which do you consider the most suitable? Give your reasons.

20. A Loan has been granted on a Policy which has become a claim. Up to what date would you charge interest on the Loan? Give your reasons, and state what other possible dates may be adopted.

SUBJECT No. 19—COMMERCIAL BOOK-KEEPING AND PUBLISHED ACCOUNTS OF INSURANCE COMPANIES.

(*Two hours allowed for this Examination.*)

Exercise B and Question D are optional.

A. Explain what is meant by:—

Assets; Liabilities; Capital—as applied to an individual trader and to a company; Income and Expenditure; Insurer; Reserve Fund—when is this an asset and when a liability?

B. From the after-mentioned particulars draw up a Profit and Loss Account, and show net profit or net loss:—

Discounts allowed to Debtors, £269; Discounts allowed by Creditors, £300; Interest from Consols, £33; Wages and Salaries, £950; Rents, Rates, and Taxes, £410; Depreciation of Stock, £175; Interest charged on Capital, £230; Gross Profit on Trading, £5733; Loss on Consols, £60.

C. From the following Trial Balance prepare a Revenue Account and a Balance Sheet:—

	Dr. £	s.	d.	Cr. £	s.	d.
Bank A/c.	70,000	0	0	——		
Cash A/c.	248	0	0	——		
Management Expenses A/c. ...	18,221	0	0	——		
Sundry Creditors for Management A/c.	——			690	0	0
Commission A/c.	9,986	0	0	——		
Premiums A/c.	——			200,543	0	0
Annuity Certificates A/c.	——			31,829	0	0
Agents' A/c.	713	0	0	——		
Claims and Bonuses A/c.	125,365	0	0	——		
Claims Payable A/c.	——			6,420	0	0
Annuities A/c.	17,978	0	0	——		
Surrender Values A/c.	10,304	0	0	——		
Interest, Dividends, and Rents A/c.	——			44,680	0	8
Society's Property A/c.	30,700	0	0	——		
Consols A/c.	50,320	0	0	——		
Mortgages A/c.	599,549	0	0	——		
Railway Debentures and Preference Shares A/c.	463,768	0	0	——		
Loans on the Company's Policies A/c.	40,684	0	0	——		
Life and Annuity Fund (at start of year)	——			1,153,674	0	0
	£1,437,836	0	0	£1,437,836	0	0

D. State the function of a Journal in :—

(*a*) Insurance Book-keeping.
(*b*) Commercial Book-keeping.

E. Name the sources of profit in :—

(*a*) A Fire Insurance Company.
(*b*) A Life Insurance Company.

NAMES OF SUCCESSFUL CANDIDATES.

The following is the Official List of the Successful Candidates at the Examinations, held simultaneously at the several Insurance centres in May, 1899. The letter "P" opposite a name signifies Pass, and "H" Honours.

	Chemistry.	Electricity.	Plan Drawing to Scale.	Building Construction.	Processes of Manufacture.				Fire Tariffs.			Fire Policy Drafting.			Fire Guarantee Work.	Law of Fire Insurance.	Mathematics.	Life Office Work.	Book-keeping.	Employers' Liability Insurance.	Personal Accident Insurance.	Shorthand and Type-writing.	Marine Insurance.
					Woollen.	Corn.	Leather.	Engineering.	Woollen Mills.	Corn Mills, No. 2.	Shops.	Woollen Mills.	Corn Mills.	Shops.									
Cary, H. W., *Royal*, Bristol	...	...	...	...	...	...	...	...	...	...	...	...	H	H	...	...	...	...	...	...	...	...	...
*Colchester, F. E., *Commercial Union*, Bristol	...	...	P	H	H	P	H	...	...	H	H	...	P	H	H	H	...	...	...	...	...	...	...
Gillingham, S. J., *Northern*, Bristol	...	...	...	...	H	P	...	...	...	P	P	...	...	H	P	...	...	P	P	...	...	...	...
Goodwin, J. H., *Guardian*, Bristol	...	...	...	...	H	...	...	...	...	...	...	...	...	H	H	...	...	...	...	...	...	...	...
Griffiths, D., *Alliance*, Bristol	P	...	P	...	...	...	...	...	...	...	P	...	...	H	P	P	...	...	...	...	...	...	...
King, W. S., *Law Union and Crown*, Bristol	...	...	...	...	...	...	...	...	...	...	P	...	H	H	H	...	P	P	...	...	...	...	...
Pool, W. H., *Northern*, Bristol	...	...	...	...	...	...	...	...	...	P	P	...	P	H	H	...	...	...	...	...	...	...	...
Smith, P. R., *Commercial Union*, Bristol	P	...	...	...		...	H	...	P	...	H	P	...	H	H	...	...	...	...	...	...	...	...
Witherspoon, R. E., *Royal Exchange*, Bristol	...	...	...	...	...	P	P	...	...	...	...	...	P	H	P	...	...	...	...	...	...	...	...

Bennett, A. J., *Royal Exchange*, Birmingham	...	...	P	...	...	P	H	P	...	P	H	...	...	H	P	...	...	...	...	...	...	...	...
Clarkson, C. R. W., *Norwich Union Fire*, Birmingham	...	...	...	...	...	...	...	...	...	P	P	...	...	H	H	...	...	...	...	...	...	...	...
Hughes, W. P., *Norwich Union Fire*, Birmingham	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...	...	...	...	...	...	...
Williams, C. B., *Imperial*, Birmingham	...	...	...	...	...	...	...	...	...		...	...	...	H	...	...	...	...	...	...	...	...	...
Butler, S. P., *Royal*, Dublin	...	...	...	...	...	...	P	...	...	H	H	...	P	H	H	...	...	...	...	...	...	...	...
Christian, N., *London and Lancashire*, Dublin	...	...	...	...	...	...	...	...	...	H	P	...	...	P	H	P	...	...	...	...	...	...	...
Keating, H. A., *Sun*, Dublin	...	...	...	...	...	...	...	...	...	H	H	...	P	H	H	...	...	...	...	...	...	...	...
M'Nab, W. R., *Guardian*, Dublin	...	...	...	P	H	H	...	...	...	H	H	H	P	H	H	...	...	...	...	...	...	...	...
O'Galligan, H., *London and Lancashire*, Dublin	...	...	...	...	...	...	...	...	...	...	P	...	...	H	P	P	...	...	...	...	...	...	...
Tyner, W. B., *Standard*, Dublin	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	P	...	...	...	...
Brown, jun., R. *General Accident*, Perth	...	...	...	...	H	...	...	...	H	...	H	...	...	H	H	P	...	...	...	...	...	...	...
Crawford, A. W., *City of Glasgow*, Glasgow	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...
Laidlaw, J. H., *North British and Mercantile*, Glasgow	...	...	P	P	...	...	P	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Laing, J. M., *British Empire*, Glasgow	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	P	H	...	...	...	...
Lang, J. C., *City of Glasgow*, Glasgow	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...	...	...	...
Macdonald, F. A., *Union*, Glasgow	...	...	P	P	...	P	H	...	...	H	P	...	P	H	H	H	...	...	...	...	...	...	...
Scott, P. M., *Norwich Union Life*, Glasgow	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...
Stewart, T., *Commercial Union*, Glasgow	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...
Watson, W., *Union*, Glasgow	P	...	...	...	...	...	...	...	...	H	H	...	P	H	H	H	...	...	...	...	...	...	...

NAMES OF SUCCESSFUL CANDIDATES, 1899—*continued.*

	Chemistry.	Electricity.	Plan Drawing to Scale.	Building Construction.	Processes of Manufacture.				Fire Tariffs.			Fire Policy Drafting.			Fire Guarantee Work.	Law of Fire Insurance.	Mathematics.	Life Office Work.	Book-keeping.	Employers' Liability Insurance.	Personal Accident Insurance.	Shorthand and Type-writing.	Marine Insurance.
					Woollen.	Corn.	Leather.	Engineering.	Woollen Mills.	Corn Mills, No. 2.	Shops.	Woollen Mills.	Corn Mills.	Shops.									
Adams, W. E., *British Law*, Leeds	...	...	...	...	P	P	...	...	...	...	...	...	...	...	...	H	P	...	...	...	...	...	...
Banks, H., *North British and Mercantile*, Leeds	...	...	...	...	P	...	...	...	...	...	...	P	...	H	H	...	...	...	...	...	...	...	...
Cooke, F. C., *Liverpool and London and Globe*, Leeds ...	H	P	...	...	H	...	H	...	H	...	H	H	...	H	H	...	...	...	...	...	...	...	...
*Cooke, H., *Liverpool and London and Globe*, Leeds ...	P	P	P	H	H	...	H	...	P	...	H	H	...	H	H	...	...	...	...	...	...	...	...
Craven, A. E., *Patriotic*, Leeds	H	...	...	...	H	...	H	H	...	...	H	P	...	H	H	...	...	...	...	...	...	...	...
Dixon, R. A., *Liverpool and London and Globe*, Leeds ...	H	H	P	H	H	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Foster, J. W. W., *Liverpool and London and Globe*, Leeds	P	...	...	...	H	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Freeman, S. E., *Sun*, Leeds	...	...	...	...	P	...	H	...	H	...	P	H	...	H	H	...	...	...	...	...	...	...	...
Giddings, H. H., *National of Ireland*, Leeds	...	P	...	...	P	...	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Grunwell, V., *Hand-in-Hand*, Leeds	P	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Higgins, E. A., *Phœnix*, Leeds	...	...	...	P	P	...	H	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
*Lithgow, G., *Sun*, Leeds	...	P	H	H	H	...	P	H	P	...	P	H	...	H	H	...	...	...	...	...	...	...	...
Metcalf, T. C., *Atlas*, Leeds	...	P	...	...	H	...	H	...	...	...	H	P	...	H	H	...	...	...	...	...	...	...	...

Oates, F. E., *Commercial Union*, Leeds	H	P	P	P	P	H	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Purchon, G., *Royal*, Leeds	...	...	...	...	P	...	...	H	H	...	H	H	...	H	P	...	...	...	...	...	...	...	...
Potter, G., *Sun*, Leeds	...	...	P	...	H	...	...	P	...	...	...	H	...	H	H	...	...	...	...	...	...	...	...
Turner, G., *Liverpool and London and Globe*, Leeds	...	...	P	...	H	...	P	...	H	...	P	H	...	H	H	...	...	...	...	...	...	...	...
Tetley, H., *Commercial Union*, Leeds	H	P	P	P	H	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cooper, T. R., *Yorkshire*, York	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	P	...	...	...	...
Carter, A. B., *Yorkshire*, York	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...	...	...	...
Dodwell, H. M., *Yorkshire*, York	...	...	...	...	H	H	...	...	...	H	H	...	P	P	H	H	...	...	...	...	...	...	...
Millburn, E W., *Yorkshire*, York	...	...	...	...	H	H	P	...	H	H	...	...	...	H	H	H	...	...	...	...	...	...	...
Wood, H. H., *Yorkshire*, York	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...
Adcock, E. E., *U. Kingdom Temperance & Gen.*, Leicester	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...	...	...	...	...	...	...
Bussell, F. G., *Liverpool and London and Globe*, Liverpool	...	H	P	H	...	...	...	...	...	...	P	...	...	H	...	...	...	...	...	...	...	...	...
Kelly, G., *Northern*, Liverpool	...	...	...	...	...	...	...	...	...	...	P	...	...	H	P	...	...	...	P	...	...	...	...
Parry, J. P., *Royal*, Liverpool	...	...	...	...	H	P	...	...	...	...	H	...	...	H	H	P	H	...	...	...	...	...	...
Blok, H. S., *Sun*, London	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...
Bell, A. D., *Lancashire*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...	...	...	...	...
Brierley, W. E., *Refuge*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	P	...	...	...	...	...
Bostock, C. L., *Norwich Union*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	H	P	...	...	...	...	...	...	...	...

NAMES OF SUCCESSFUL CANDIDATES, 1899—*continued.*

	Chemistry.	Electricity.	Plan Drawing to Scale.	Building Construction.	Processes of Manufacture. Woollen.	Processes of Manufacture. Corn.	Processes of Manufacture. Leather.	Processes of Manufacture. Engineering.	Fire Tariffs. Woollen Mills.	Fire Tariffs. Corn Mills, No. 2.	Fire Tariffs. Shops.	Fire Policy Drafting. Woollen Mills.	Fire Policy Drafting. Corn Mills.	Fire Policy Drafting. Shops.	Fire Guarantee Work.	Law of Fire Insurance.	Mathematics.	Life Office Work.	Book-keeping.	Employers' Liability Insurance.	Personal Accident Insurance.	Shorthand and Type-writing.	Marine Insurance.
Cawley, A. P., *Northern*, Manchester	...	...	...	...	...	...	...	...	...	P	H	...	...	H	H	H	...	H	...	...	...	...	...
Coe, H. G., *Lancashire*, Manchester	...	H	...	...	...	...	...	...	...	H	H	...	...	H	H	...	...	...	...	...	...	...	...
Crass, P. A., *Lancashire*, Manchester...	...	H	...	...	...	...	...	...	...	...	P	...	...	H	P	...	P	...	...	...	...	...	...
Cowan, H., *Scottish Alliance*, Manchester	...	...	...	...	...	...	...	...	...	...	H	...	...	H	H	...	...	...	...	...	...	...	...
Carter, W. T., *Commercial Union*, Manchester	...	P	...	...	...	...	...	...	...	...	P	...	H	H	H	H	...	...	...	...	...	...	...
Dawes, S. H., *Commercial Union*, Manchester	...	P	...	...	...	...	...	..	...	...	...	...	...	H	H	H	...	...	...	...	...	...	...
Elliott, A. C., *Atlas*, Manchester	...	...	...	...	...	...	...	...	...	...	P	...	...	H	...	...	...	...	...	...	...	...	...
Frank, H., *Manchester*, Manchester	...	H	...	...	...	...	...	...	...	H	H	...	P	H	H	...	...	...	...	...	...	...	...
Gleave, C. S., *Refuge*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	P	...	...	...	...	...
Goodwin, A. D., *Union*, Manchester	...	H	...	...	...	...	...	...	...	P	H	...	H	H	H	H	...	...	...	...	...	...	...
Gilson, T. C., *National*, Manchester	...	...	...	...	...	...	...	...	...	H	H	...	...	...	H	H	...	...	...	...	...	...	...
Holiday, G. E., *Lancashire*, Manchester	...	P	...	...	...	...	...	...	...	H	P	...	P	H	P	...	...	...	...	...	...	...	...
Horsfall, B. E., *Atlas*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...	...	...	...	...	...	...

Hall, W. E., *Guardian*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	P	...	...
Holt, A. J., *Caledonian*, Manchester	...	...	...	...	...	...	...	...	...	...	P	...	...	H	P	...	...	...	...	...	...	...	...
Heinke, C. C. S., *Co-operative*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	H	H	...	...	...	...	...	...	...	...
Harrison, T. R., *Royal Exchange*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...	...	...	...	...	...
Hood, G., *Scottish Union and National*, Manchester	...	P	P	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...	...
Hay, A. McKay, *Lancashire*, Manchester	...	P	...	...	...	...	...	...	...	H	H	...	...	P	H	...	...	...	...	...	...	...	...
Leadsom, W. H., *Alliance*, Manchester	...	P	...	...	...	...	...	...	...	H	H	...	H	H	H	...	...	...	...	...	...	...	...
Leah, S. P., *Co-operative*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...	...	...
Mercer, P., *Standard*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...	...	...
Plummer, R., *Manchester*, Manchester	...	P	...	...	...	...	...	...	...	H	H	...	...	H	H	...	...	...	...	...	...	...	...
Plummer, N. K., *Liverpool and London and Globe*, M'chester	...	P	...	...	...	...	...	...	...	H	P	...	H	H	H	...	...	...	...	...	...	...	...
Street, F., *Equitable*, Manchester	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Smith, E., *Lancashire*, Manchester	...	...	...	...	...	...	...	...	...	P	P	...	...	H	P	...	...	...	...	...	...	...	...
Swainston, F. R., *Alliance*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	H	P	...	P	...	...	...	...	...	...
Schofield, J. W. K., *Law Union and Crown*, Manchester	...	P	...	...	...	...	...	...	...	H	H	...	H	H	H	...	...	...	...	...	...	...	...
Stansfield, A. W., *Caledonian*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...	...	...	...	...	...	...
Trenan, W., *British Law*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...	...	...	...	...	...	...
Williams, L., *Atlas*, Manchester	...	...	...	...	...	...	...	...	...	P	H	...	...	P	P	...	...	...	...	...	...	...	...
Webb, S., *Norwich Union*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...	...	...	...	...	...	...
Hines, E. E., *Commercial Union*, Norwich	...	P	P	P	...	...	...	...	...	H	H	...	...	H	H	H	...	...	P	...	...	...	...

NAMES OF SUCCESSFUL CANDIDATES, 1899—*continued.*

	Chemistry.	Electricity.	Plan Drawing to Scale.	Building Construction.	Processes of Manufacture.				Fire Tariffs.			Fire Policy Drafting.			Fire Guarantee Work.	Law of Fire Insurance.	Mathematics.	Life Office Work.	Book-keeping.	Employers' Liability Insurance.	Personal Accident Insurance.	Shorthand and Type-writing.	Marine Insurance.
					Woollen.	Corn.	Leather.	Engineering.	Woollen Mills.	Corn Mills, No. 2.	Shops.	Woollen Mills.	Corn Mills.	Shops.									
Walton, W. C., *Norwich Union*, Norwich	...	...	...	...	...	...	...	...	...	H	H	...	...	H		P	...	...	...	...	...	...	...
Caswell, T. H., *Commercial Union*, Nottingham	...	...	...	...	...	...	...	...	...	P	P	...	...	H	P	...	...	...	...	...	...	...	...
Dignon, E., *Commercial Union*, Nottingham	...	...	...	...	...	...	...	...	...	P	P	...	...	P	H	P	...	...	...	...	...	...	...
Drinkwater, J., *Northern*, Nottingham	...	...	...	...	...	...	...	...	...	P	P	...	...	H	H	...	...	...	...	...	...	...	...
Hill, F. N., *Norwich and London Accident*, Nottingham ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...
M'Michael, D., *Commercial Union*, Nottingham	...	P	...	...	...	...	...	...	...	H	H	...	H	H	H	P	...	...	...	...	...	...	...
Rawson, W. J. S., *Northern*, Nottingham	...	...	...	...	...	...	...	H	...	...	P	...	...	...	H	P	...	...	...	...	...	...	...
Truzzell, H., *Northern*, Nottingham	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...	...

* Those thus marked were awarded "Special Merit."

NAMES OF SUCCESSFUL CANDIDATES—1900.

The following is the Official List of the Successful Candidates at the Examinations, held simultaneously at the several Insurance centres in May, 1900. The letter "P" opposite a name signifies Pass, and "H" Honours.

	Electricity.	Plan Drawing to Scale	Processes of Manufacture.				Tariffs.			Policy Drafting.			Law of Fire Insurance.	Employers' Liability.	Correspondence (Fire).	Correspondence (Life).	Mathematics.	Life Assurance and Life Office Work.	Book-keeping.
			Woollen.	Flour Milling	Tanning and Currying.	Machine Making.	Woollen Mills.	Corn Mills.	Tanneries.	Woollen Mills.	Corn Mills.	Tanneries.							
Cramp, F. C., *Royal Exchange*, Birmingham	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...
Davenport, F., *Patriotic*, Birmingham	...	...	...	...	H	...	...	...	H	...	...	...	...	...	...	...	...	...	...
Edmunds, G. A., *Northern*, Birmingham	...	...	...	...	H	...	...	...	H	...	...	P	P	...	...	...	...	...	P
Henshall, T., *Lancashire*, Birmingham	...	...	...	...	...	...	...	...	...	...	...	...	P	...	P	...	...	...	...
Holt, J. H. L., *Norwich Union Fire*, Birmingham ...	...	...	...	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Jones, D. S., *Atlas*, Birmingham	...	...	...	P	H	...	...	...	...	...	...	P	...	...	...	...	...	...	...
Miller, N., *Law Union and Crown*, Birmingham	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	P	...
Milligan, H. S., *Law Union and Crown*, Birmingham ...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...
Parker, H. H., *Scottish Provident*, Birmingham	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...

NAMES OF SUCCESSFUL CANDIDATES, 1900—*continued.*

	Electricity.	Plan Drawing to Scale	Processes of Manufacture. Woollen.	Processes of Manufacture. Flour Milling	Processes of Manufacture. Tanning and Currying.	Processes of Manufacture. Machine Making.	Tariffs. Woollen Mills.	Tariffs. Corn Mills.	Tariffs. Tanneries.	Policy Drafting. Woollen Mills.	Policy Drafting. Corn Mills.	Policy Drafting. Tanneries.	Law of Fire Insurance.	Employers' Liability.	Correspondence (Fire).	Correspondence (Life).	Mathematics.	Life Assurance and Life Office Work.	Book-keeping.
Plummer, N. C., *Northern*, Birmingham	...	P	...	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...
*Turner, H. E., *Scottish Union and National*, Birmingham	H	...	...	...	H	H	...	...	H	...	...	P	...	...	...	...	...	...	...
Gillingham, S. J., *Northern*, Bristol	...	...	...	...	H	H	...	...	P	...	...	...	...	...	...	...	...	...	...
Goodwin, J. H., *Guardian*, Bristol	...	...	...	...	...	...	...	P	P	...	...	...	...	...	...	...	...	...	...
James, E. B. C., *Northern*, Bristol	...	...	...	...	H	...	...	...	H	...	...	...	...	...	...	...	...	..	...
King, W. S., *Law Union and Crown*, Bristol	...	...	...	...	...	...	...	...	H	...	...	...	...	...	P	...	...	...	...
Mulleny, G., *Northern*, Bristol...	...	...	H	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Phillipps, L. H., *Commercial Union*, Bristol...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...	...	...	...	...
Poole, W. H., *Northern*, Bristol	...	...	...	...	H	...	...	...	P	...	...	P	...	...	...	...	...	...	...
Smith, P. R., *Commercial Union*, Bristol	...	...	...	P	...	...	...	...	...	...	P	...	...	...	...	...	...	...	...
Warner, F. G., *Commercial Union*, Bristol	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...
Witherspoon, R. E., *Lancashire*, Bristol	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...
Butler, S. P., *Royal*, Dublin	...	...	...	P	...	...	...	...	P	...	...	...	...	...	...	...	...	...	...

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Jackson, S. F., *Sun*, Dublin	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...	...	...
Keatinge, H. A., *Sun*, Dublin	...	...	...	...	...	...	...	...	H	...	...	H	...	...	P	...	...	...	...
Lemon, J. H., *Sun*, Dublin	...	...	...	...	...	...	...	P	...	...	...	...	...	...	...	...	...	...	...
M'Nab, W. R., *Guardian*, Dublin	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sparrow, G. F., *Guardian*, Dublin	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tyner, W. B., *Standard*, Dublin	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...
Brown, Jun., R., *General Accident*, Perth	...	...	...	P	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Crawford, A. W., *City of Glasgow*, Glasgow	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...
Jopp, J. H. M., *North British and Mercantile*, Glasgow	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...
Laidlaw, J. H., *North British and Mercantile*, Glasgow	...	...	...	P	...	...	...	...	P	...	...	P	...	...	...	...	...	...	...
M'Clure, S., *Guardian*, Glasgow	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...	...	...
MacGill, G. R., *Alliance*, Glasgow	...	...	...	P	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...
Waters, W. W., *Northern*, Glasgow	...	...	...	...	...	...	P	...	...	...	...	...	...	...	P	...	...	...	...
Bastow, J. A., *Atlas*, Leeds	...	...	...	...	...	...	...	...	P	...	...	P	...	...	...	...	...	...	...
Bond, W., *Commercial Union*, Leeds	...	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bradford, F., *Royal Exchange*, Leeds	...	P	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Coates, A. O., *Lion*, Leeds	...	...	P	...	H	...	P	...	H	...	...	P	...	...	...	P	...	...	...
Cooke, H., *Liverpool and London and Globe*, Leeds	...	...	...	H	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...
Craven, A. E., *Patriotic*, Leeds	...	...	...	...	...	...	...	...	...	...	...	...	P	H	...	...	...	...	...

NAMES OF SUCCESSFUL CANDIDATES, 1900—*continued.*

	Electricity.	Plan Drawing to Scale	Processes of Manufacture.				Tariffs.			Policy Drafting.			Law of Fire Insurance.	Employers' Liability.	Correspondence (Fire).	Correspondence (Life).	Mathematics.	Life Assurance and Life Office Work.	Book-keeping.
			Woollen.	Flour Milling	Tanning and Currying.	Machine Making.	Woollen Mills.	Corn Mills.	Tanneries.	Woollen Mills.	Corn Mills.	Tanneries.							
Dalton, H., *Lancashire*, Leeds...	...	...	P	...	...	...	...	...	...	H	...	...	P	...	...	...	...	...	...
Dixon, R. A., *Liverpool and London and Globe*, Leeds ...	...	...	...	P	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...
†Eckford, J. P., *Royal Exchange*, Leeds	...	...	...	...	H	...	...	...	...	...	...	...	...	...	H	...	H	...	P
Foster, J. W. W., *Liverpool and London and Globe*, Leeds	...	...	...	...	...	...	...	...	P	...	...	H	...	...	...	...	...	...	...
Mallett, F. C., *Atlas*, Leeds	...	...	P	...	...	...	...	...	...	P	P	...	...	...	...	...	...	...	...
Metcalf, W. E., *North British and Mercantile*, Leeds ...	...	...	...	...	...	...	P	...	...	H	...	H	P	...	H	...	...	...	...
Metcalf, T. C., *Atlas*, Leeds	...	P	...	...	...	...	P	...	P	...	...	H	...	...	P	P	...	...	...
*Oates, F. E., *Westminster Fire*, Leeds	...	...	...	...	...	...	...	H	H	...	...	H	P	...	P	...	...	...	...
Plant, J. E., *Lancashire*, Leeds	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...
Purchon, G., *Royal*, Leeds	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sutcliffe, H. R., *Phœnix*, Leeds	...	...	...	...	H	...	...	...	P	...	...	P	...	...	...	...	...	...	...
Tetley, H., *Commercial Union*, Leeds	...	...	...	...	...	...	...	...	H	...	...	...	...	...	...	...	...	...	...
Turner, G., *Liverpool and London and Globe*, Leeds ...	...	H	...	...	...	...	...	...	P	...	...	...	...	...	P	...	...	...	...

Barbour, A., *Equitable*, Bradford	...	...	H	...	...	...	H	...	...	P	...	...	...	...	...	...	...	...	...
Hodgson, F. E., *Friends Provident*, Bradford	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H
Reid, R., *Equitable*, Bradford	...	...	P	...	...	...	...	...	...	P	...	...	...	...	P	...	...	...	...
Cooper, T. R., *Yorkshire*, York	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...
Dodwell, H. M., *Yorkshire*, York	...	...	...	...	H	...	P	...	P	...	...	P	...	...	P	...	...	...	...
Monkman, P. L., *Yorkshire*, York	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...
Dodd, J., *Royal*, Liverpool	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...	...
Mitchell, T. K. O., *Royal*, Liverpool	P	...	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sykes, E., *Royal*, Liverpool	...	...	P	...	H	...	P	...	H	...	...	...	...	...	...	...	...	...	...
Combes, E. H., *Yorkshire*, London	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...
†Gerrard, J. G., *Royal*, London	P	P	...	P	H	...	...	H	P	...	P	P	...	...	P	...	...	...	...
Healy, L. T., *Royal*, London	P	...	...	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pringle, H. M., *British Law*, London	...	...	...	...	H	...	...	...	P	...	...	...	...	...	P	...	...	...	...
Barker, S., *Union*, Manchester	...	...	...	...	H	...	...	...	...	...	...	P	...	...	...	...	...	...	...
Boughey, W. O., *Palatine*, Manchester	...	...	...	...	...	...	...	...	H	...	...	...	P	...	P	...	...	...	...
Briscoe, H. P., *Palatine*, Manchester	...	...	...	H	...	...	...	P	...	...	H	...	P	...	P	...	...	...	...
Cawley, A. P., *Northern*, Manchester	...	P	...	...	...	...	...	...	...	...	P	P	...	...	P	P	...	...	...
Coe, H. G., *Lancashire*, Manchester	...	...	...	...	H	...	...	...	H	...	...	...	...	...	...	...	...	...	...
Collinge, W., *Guardian*, Manchester	...	...	...	P	H	...	...	P	P	...	...	...	...	...	...	...	...	...	...

NAMES OF SUCCESSFUL CANDIDATES, 1900—*continued.*

	Electricity.	Plan Drawing to Scale	Processes of Manufacture. Woollen.	Processes of Manufacture. Flour Milling	Processes of Manufacture. Tanning and Currying.	Processes of Manufacture. Machine Making.	Tariffs. Woollen Mills.	Tariffs. Corn Mills.	Tariffs. Tanneries.	Policy Drafting. Woollen Mills.	Policy Drafting. Corn Mills.	Policy Drafting. Tanneries.	Law of Fire Insurance.	Employers' Liability.	Correspondence (Fire).	Correspondence (Life).	Mathematics.	Life Assurance and Life Office Work.	Book-keeping.
Cowan, H., *Scottish Alliance*, Manchester	...	P	...	...	H	...	...	...	P	...	...	P	...	...	...	...	...	...	...
Crass, P. A., *Lancashire*, Manchester	...	...	...	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...
*Frank, H., *Manchester*, Manchester	...	P	H	P	H	...	...	...	P	P	P	H	P	...	P	...	...	...	...
Greenhorne, J. H., *Northern*, Manchester	...	P	...	H	H	...	...	...	P	...	P	H	...	...	...	...	...	...	...
Harrison, T. R., *Royal Exchange*, Manchester	...	...	...	P	H	...	...	P	...	...	...	P	...	...	...	...	...	...	...
Hay, A. M'K., *Lancashire*, Manchester	...	...	...	P	H	...	...	...	P	...	...	...	...	...	...	...	...	...	...
Hobbins, A. E., *Guardian*, Manchester	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hood, G., *Scottish Union and National*, Manchester ...	...	...	...	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Lowe, P. T., *Royal Exchange*, Manchester	...	...	...	...	P	...	...	...	...	...	...	P	...	...	...	...	...	...	...
Mattinson, L. K., *Palatine*, Manchester	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nicholl, A., *Edinburgh Life*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...
Plummer, N. K., *Liverpool and London and Globe*, Manchester	...	...	...	...	...	...	...	...	H	...	...	H	...	...	...	...	...	...	...
Pollard, F. J., *Atlas*, Manchester	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...	...
†Schofield, J. W. K., *Law Union and Crown*, Manchester	...	P	...	P	H	...	...	...	H	...	...	P	P	...	...	...	...	...	...

Sharpe, E., *Guardian*, Manchester	...	...	...	P	H	...	...	P	P	...	...	...	...	...	...	...	...	...	...
Smith, A. C., *Palatine*, Manchester	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Walker, A., *Lancashire and Yorkshire Accident*, Manchester	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...
Whittaker, H., *Liverpool and London and Globe*, Manchester	...	...	...	...	...	...	...	...	P	...	...	...	...	...	...	...	...	...	...
Wrigley, James, *Palatine*, Manchester	...	...	...	...	...	...	...	P	...	...	P	...	...	...	...	...	...	...	...
Armstrong, R. P., *Royal Exchange*, Newcastle-on-Tyne ...	...	...	...	...	H	...	...	...	...	...	...	P	...	...	...	...	...	...	...
Binney, G. W., *Lancashire*, Newcastle-on-Tyne	...	...	...	P	...	P	...	P	...	...	P	...	...	...	...	...	...	...	...
Ferry, T. W., *Liverpool and London and Globe*, Newcastle-on-Tyne	...	P	...	...	H	P	...	...	P	...	...	...	...	...	...	...	...	...	...
Henderson, G. E., *Royal*, Newcastle-on-Tyne	...	...	...	...	...	...	...	...	P	...	...	P	...	...	...	...	...	...	...
Liddell, W. T., *Royal*, Newcastle-on-Tyne	...	...	...	...	H	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Lloyd, T. P., *Northern*, Newcastle-on-Tyne	...	...	...	...	H	H	...	...	H	...	...	...	...	...	H	...	...	...	...
Richardson, O. B., *Northern*, Newcastle-on-Tyne	...	...	...	...	P	P	...	...	...	...	...	...	...	...	...	...	...	...	...
Robinson, H. T., *Royal*, Newcastle-on-Tyne	...	...	...	...	P	...	...	...	...	...	...	...	...	...	...	P	...	...	...
Wilcox, F. C., *Northern*, Newcastle-on-Tyne	...	...	...	...	H	P	...	...	P	...	...	...	...	...	...	...	...	...	...
Self, E., *Norwich Union Fire*, Norwich	...	...	...	...	P	...	...	...	...	...	...	P	...	...	...	...	...	...	...
Walton, W. C., *Norwich Union Fire*, Norwich	...	...	...	P	...	...	...	...	P	...	...	P	...	...	...	...	...	...	...
Boon, R. L., *Royal*, Nottingham	...	P	...	...	...	...	...	...	P	...	...	...	...	...	...	...	P	...	...
Caswell, T. H., *Commercial Union*, Nottingham	...	...	...	...	...	...	...	...	P	...	...	P	...	...	...	...	...	...	...

NAMES OF SUCCESSFUL CANDIDATES, 1900—*continued.*

	Electricity.	Plan Drawing to Scale	Processes of Manufacture. Woollen.	Processes of Manufacture. Flour Milling	Processes of Manufacture. Tanning and Currying.	Processes of Manufacture. Machine Making.	Tariffs. Woollen Mills.	Tariffs. Corn Mills.	Tariffs. Tanneries.	Policy Drafting. Woollen Mills.	Policy Drafting. Corn Mills.	Policy Drafting. Tanneries.	Law of Fire Insurance.	Employers' Liability.	Correspondence (Fire).	Correspondence (Life).	Mathematics.	Life Assurance and Life Office Work.	Book-keeping.
Drinkwater, J., *Northern*, Nottingham	...	...	...	...	...	...	...	P	P	...	P	...	...	...	...	...	...	...	...
Hill, C. S., *Northern*, Nottingham	...	...	...	...	...	...	...	...	H	...	...	...	...	...	...	...	...	...	...
Hill, F. N., *Norwich and London Accident*, Nottingham ...	...	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...	...
Lowe, N. D., *Hand-in-Hand*, Leicester	...	P	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Smith, S. H. W., *Commercial Union*, Nottingham	...	...	...	...	...	...	...	...	P	...	...	P	...	...	...	...	...	...	...
Truzzell, H., *Northern*, Nottingham	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	H	...	...	...
Wilson, A. E., *Hand-in-Hand*, Leicester	...	P	...	...	...	...	...	...	...	...	...	...	...	...	P	...	...	...	...

* Special Merit. † Honourable Mention.